Improving university science teaching and learning

pedagogical projects 2009

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The aim of the series is to provide insight into the kinds of educational tasks and problems new teachers are facing, and to show how they manage them in inspiring ways.

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Improving University Science Teaching and Learning

Pedagogical Projects 2009

Volume 2, Number 2

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Introduction

Frederik Voetmann Christiansen and Jan Sølberg

Department of Science Education

Introduktion

This anthology represents a collection of project papers written and developed in conjunction with a teacher development program (TDP) offered to academic staff across three faculties at the University of Copenhagen. The program consists of a practical part, where participants' teaching is supervised by senior teachers, and a theoretical part where participants are introduced to fundamental pedagogical principles of relevance to university science teaching and learning. In the theoretical part, participants also make two projects: One related to student learning, and one that is specifically aimed at developing their own teaching. This volume contains these final projects for the participants in the TDP in 2008/2009. For further description and information about of the TDP, see (Christiansen et al.; 2009). The course was given in Danish, but many participants have chosen to write their final projects in English. As a result, the current volume has contributions in both English and Danish.

The contributions in the series are not scientific papers as such, although several contributions do have potential to become that. Instead, they are personal accounts of how and why teaching has been developed in various ways. As such, the contributions tell us how teachers actually work in developing their courses, and show us what they learn in the process. In this sense the papers show us something that scientific papers often fail to show.

Many of the contributions analyse teaching where something went wrong and consider the lessons to be drawn from those situations. Good teachers see such situations as opportunities for improving their practice,

but only rarely do such accounts find their way to the peer-reviewed educational journals. Likewise, many of the problems described in the contributions are problems that are relatively specific to the teaching institution at hand, and this specificity is also something which is ordinarily downplayed or even erased in publications addressed to a more general audience. Here, we have the unpolished situations described in their specific ugliness and beauty, and see the teachers' attempts at bringing general considerations to bear on them. Most of the contributions show that this endeavour is relatively successful. In this way, what the contributions may lack in scientific rigour, they have in authenticity – and honesty. In this sense the contributions in this series can be seen as complementary to standard scientific papers, rather than mimicking them. In improving university science teaching and learning, we may learn a lot from studying the personal development projects in this volume (and series).

The types of problems dealt with in the development projects are very diverse, but the approaches to dealing with the problems show a common approach: Focussing on student outcomes rather than presenting mere content. In this respect, it is clear that the teaching material used in the course, particularly John Biggs and Catherine Tangs description of "constructive alignment" (Biggs & Tang; 2007), has been an important source of inspiration for many of the participants.

We have chosen to divide the volume into three different parts according to the projects main focus:

1. Course structure analyses
2. Course development
3. Students' learning outcomes.

The individual contributions will be introduced below.

Course structure analyses

Birgitte Ask has written a project on the constructive alignment of the course "Almen Husdyravl". In her analysis she uses student evaluations, teachers' experiences and careful reflection to point to a number of weaknesses in the course design. Based on the theory of constructive alignment, she thoroughly analyses the course looking at stated learning objectives, target group composition, course structure, teaching and learning activities as well as evaluation schemes. Each of these aspects is dealt with in a

thoughtful and systematic way and her suggestions support a closer alignment between leaning objective, course content and evaluation. Through her analyses she poses a number of detailed suggestions for improvements that are well substantiated and carefully thought through.

Charlotte Helgstrand's project concerns the course in Philosophy of Science at the Pharmacy study at the University of Copenhagen. Charlotte Helgstrand has been involved in the teaching in 2009, and the project presents reflections and outcomes of discussions with teachers and former students. The project contains a number of relevant suggestions for improvement for the course in 2010, in particular concerning the organization of the project work and the general coherence of the course. Among the suggestions is a strengthening of the student groups' peer evaluation of each other. The project also contains considerations on how the gradually diminished resources for the course can be addressed in the future without compromising what teachers and students conceive as valuable in the existing course.

Peter Kjelgaard describes the continued evaluation of the course "From gene to function in pathenogenic bacteria" with the purpose of examining the alignment between intended learning outcomes descriptions, teaching and learning activities and the evaluation scheme of the course. Based on evaluation data (not presented in the project), Peter Kjeldgaard explains how course alignment seemed to be strong. However, in the second year of the course student composition had changed in a way that required a different approach to teacher instruction and detailed structure to address a more multi-cultural multi-institutional student group. The report concludes that there is a good alignment in the course and that student evaluations supported this claim.

Peter Kjeldgaard uses pedagogical/didactical theory in his report to structure his analyses of the course in question. This analysis, in turn, is used to produce insights and recommendation for improvement, which he himself has been able to implement and assess again.

Katrine Schepelern Johansen has examined to concept of constructive alignment in the third module of the Masters' programme Sundhedsantropologi. She describes the course in its current form and analyses the internal consistency of the course objectives, teaching activities and evaluation format. In her analysis she points to a problematic vagueness in the stated learning objectives and identifies a discrepancy between teaching activities dominated by oral discussion and the written format of the final exam. In her report, she produces a number of suggestions that addresses these issues without having to radically alter the course structure.

The project reflects a focussed effort to try and improve an existing course by using concept from educational theory to look for hindrances for learning within the course structure. This includes reflection on the role and importance of anthropological analysis as it is made explicit in the description of course objectives.

In her project, Kajsa Kvist describes her experiences and plans concerning the first year course in statistics for psychology students. This is a hard course to teach for several reasons: first year psychology students are not intrinsically motivated to study statistics, the course has suffered from a "bad reputation", and evaluation formats have not reinforced active learning. Kajsa Kvist describes the many changes that she has made in the course after she became course leader in 2010, and also outlines some of the changes that are planned for the future. One of the fundamental changes is a stronger coupling of statistics to psychological data sets, and increased focus on understanding. The changes have had an effect: Courser evaluations show that students now generally want to improve their statistics skills, and also find the teaching and learning activities relevant. However, many students (still) indicate that they spend too little time on the course in both absolute and relative terms. Kajsa Kvist considers the problems with constructive alignment of the course, and suggests that a change of the examination form might address this problem.

Course development

The project by Eleonora Miquel Becker and Marianne Lametsch describes the prospective ideas concerning a new course in "Molecular Food Sciences". The course is planned to be organized around weekly "theme assignments". In these assignments students are to work in groups on a cases and present their results in a poster format. The groups present to each other, and receive feedback from other students and teachers. The assignments gradually progress from a relatively closed format to a more open and challenging format where the students use what they have learned during the course. The project takes the form of a kind of proposal for the new course, complete with developed examples of relevant cases. As such the project will be extremely useful both as a discussion paper among the teachers and as a template for the remaining assignments to be developed.

In his project Christian Pipper describes the restructuring of a PhD course in applied statistics on which he has been the course director. Special

emphasis is given to new teaching and learning activities, where students progressively self-reflect on data from their own PhD projects, and discuss their self-reflections in peer-groups. The evaluations indicate, that students find the new self-reflection exercises rewarding in terms of content, structure and personal gain. However, Christian Pipper has noticed that the time spent on the self-reflection exercises were used very differently by the participants; not all students used the time in way it was intended. Particularly, some students did not use the structured approach to statistical problem solving that was encouraged in the self-reflections exercises, but on other learning activities. Thus, while the introduction of the self-reflection exercises has been highly successful, there is still some room for improvement in terms of students acquiring the intended learning outcomes.

Christian Gamborg's final project concerns the pedagogical challenges involved in teaching Philosophy of Science to Urban planning and landscape architecture students at the Faculty of Life, Univerisity of Copenhagen. Christian Gamborg argues that the challenges are related to both subject matter *content*(abundance and abstractness) and *student learning*; e.g. students are unfamiliar with this type of subject, and also with the teaching formats employed. The fact that it is large group teaching (40-100 students) may also be a barrier. Christian Gamborg argues that the way to meet the challenges with respect to content is to use exemplars that students will be able to relate to (i.e. from urban planning and landscape architecture) in the exposition of the theoretical concepts from Philosophy of Science. The challenges with respect to student learning are dealt with by organizing the lectures in a set of "mini-lectures" with peer-instruction and integrated group-based exercises. Evaluations indicate that students are very content with the course, find it relevant, and are fond of the active learning environment it provides. Thus, Christian Gamborg argues for a problem- and dialogue-based course, where students are introduced to the abstract philosophical perspectives/terms by means of problems from their specialty, which reflect the need for the perspectives. There is also an illustrative example about teaching "concepts of nature" included in the project.

Kenneth Baltzer examines the effect of using case-based learning in the first year Economics course. His states that this is an attempt to promote more functional learning among students as opposed to teaching economics from a more declarative vantage point. In his work to improve the course he fundamentally changed the teaching and learning activities of the course to be better aligned with the intended learning outcomes. His report includes

a comparative analysis of the new approach involving student evaluation, educational literature and personal reflections.

Kenneth Baltzer's paper includes many valuable points and his conclusion that declarative knowledge can be substituted with more functional knowledge has implications for many other courses.

Camilla Sichlau Bruun's project concerns the revision of a laboratory exercise in a course in "Molecular genetics / Genetics". The exercise was on DNA sequencing. Camilla Sichlau Bruun also taught this exercise last year, and her evaluation then was that many students were adopting surface strategies and (consequently) had relatively meagre learning outcomes. Camilla Sichlau Bruun identifies a number of problems in the existing exercise for this: The exercise covered too much material for the students to get real understanding, the pre-lab time was too short, and the students did not have a good understanding of the flow in the experiment. To address this issue, Camilla Sichlau Bruun revised the exercise completely, to a problem based format. The pre-lab time was extended substantially, allowing for student activities. The exercise itself was organised as a problem based case, and covered less material than before. The evaluation and exercise reports show that the changes have led to much better learning outcomes for the students. The positive experience with the revision of this exercise leads Camilla Sichlau Bruun to argue that the basic structures of this exercise could advantageously be extrapolated to other exercises.

Alexey Solodovnikov investigates the causes for problems of a low level motivation, and hence a low learning outcome, for a group of students taking the mandatory field course "Terrestrial Zoology" for biology students. After a number of years with disappointing results, the course was redesigned using problem orientation as a theoretical frame. Students were put in the position of field biologists and made to compare ecological studies of four different habitats. This way of using problem orientation lead to a more progressive sequence of teaching and learning activities, that ultimately could increase motivation among students. The paper contains a valuable analysis of the many possible causes of the motivational problems with the field work and deals with these in the redesign of the course in a way that may help others to use problem orientation in other courses.

Mette Burmølle and Lars Hestbjerg Hansen present their course development project in two parts: The first part consists of a detailed description of the development of a new master's level course called Emerging Molecular Techniques in Microbiology including a historical account of the premise and reasoning behind the course as well as pedagogical and didac-

tic considerations. The second describes how the authors evaluated the first cohort of 21 students to take the course and how the results lead them to make informed adjustments of the course. The course was designed to introduce students to frontline techniques and methods through authentic research projects thereby boosting student motivation and allowing students to engage in questions with actual potential for publication. In addition, students working in groups of three were required to share data and use other groups' data to finally write a report in the form of a research article.

The project includes analysis of both qualitative and quantitative evaluations conducted by the authors. The analysis confirms the authors in many of their initial assumptions about the course design and points to a largely successful first design requiring only minor adjustments to accommodate students' feedback.

Students' learning outcomes

In her project Charlotte Svendler Nielsen addresses the question of how students may develop bodily awareness in learning processes at the exercise and sport science study, particularly in the bachelor course "Kropsbasis" (=bodily basis). Taking a phenomenological approach, Charlotte Svendler Nielsen reflects on students' written descriptions of "significant moments" (van Manen; 1990) in the teaching. Charlotte Svendler Nielsen focuses on two aspects of bodily learning; the establishment of an alternative psychological and physical space ('et anderledes rum'), and the (increased) awareness of bodily presence and relation to others ('at kunne mærke kroppen'). The students' descriptions leave little doubt that the bodily exercises and the written follow-up actually leads them to learn about themselves, their own body and their relations to others. Charlotte Svendler Nielsen argues convincingly, that making students express themselves about what they feel, see and experience may be a useful tool towards an increased focus on bodily knowing and learning - not only in relation to dancing, but also in relation to other sport science subjects.

Rubini Maya Kannangara and Mika Zagrobelny describe their investigation of the qualities of structured student-centred teaching as used in supervision of projects at LIFE, University of Copenhagen. The project delves into details about the role of the supervision and how it affects student outcome. Using both qualitative and quantitative approaches the au-

thors follow the two students as they are being supervised throughout their 8 week projects in two different subjects.

The data presented shows that the individual background of the two students (based on laboratory experience and nationality) points to individual needs for supervision, but also that both students felt that they benefitted from the structured supervision. The project provides a thorough account of the supervision process and of how the authors conducted their investigation.

Jacob Stordal Christiansen's project concerns a masters' level course in mathematics called "Spectral Theory". The course typically attracts about 5 students and the small number of students forms the pedagogical framework for his paper. The project investigates how students can be brought to participate more in such a small class setup. The author describes his experiences during the course and an oral student evaluation conducted at the end of the course. The paper deals with all the elements involved in the course in a structured and easy-to-read way using examples to help the reader understand the subject matter of the course. The author offers practical advice based on his teaching experiences and considerations during the teaching of this course.

Dagmar A. Brüggemann has interviewed 7 non-Danish different students from 6 different countries and 5 teachers (three Danish and two non-Danish) about cultural components of learning and the teaching and study experience at the Food Science education in relation to the *Erasmus Mundus* programme *Food of Life*. The interview with students leads to observation of a number of contrasts between the Danish and the non-Danish learning experience. For instance, group work and active participation in teaching is generally weighted higher in Denmark. The students have good relations to other inter-national students, but limited contact to Danish students. The interviews with teachers shows the extremely interesting tendency that Danish teachers conceive of Danish students as superior to international students on a variety of parameters, and they feel the learning outcome is reduced in international classes compared to Danish classes. The non-Danish teachers conversely feel that the teaching benefits from international presence. Interestingly, in the course by the Danish teachers, Danish students got higher grades than international students. In the course assessed by the international teachers there was no such difference. All teachers agreed that the differences in expectations and cultural backgrounds created large problems. The author argues for increased awareness

for teachers of students' and the teachers' own cultural background and learning styles.

Heike Rösner's project concerns students' preconceptions and conceptual learning of NMR spectroscopy in relation to a course in "Protein Structure Determination". In particular, Heike Rösner has investigated how the learning of NMR spectroscopy can be accomplished without relying on the standard classical analogies/models of NMR often described in the textbooks. Heike Rösner argues convincingly, that some of these models may be impeding real understanding of the phenomena, rather than providing it. Heike Rösner has devised several ways of qualitatively investigating students' knowledge of NMR, including their preferences with respect to introduction of theoretical models and other sources of knowledge. It is concluded that omitting generalized models and analogies did not obstruct the students' learning, and that the path to expert understanding of NMR is much more complex and multifaceted than relying on standard models and analogies. This project shows how a scholarly interest in the use and limitations of analogies in learning concepts of modern physics may be transformed into relevant teaching activities and evaluation formats which really help students develop their conceptual learning of NMR.

Finally, Nina Rønsted describes the development and first run of a new curriculum in Molecular Systematics for students of Pharmaceutical Sciences. The author discusses the intended learning outcomes of the new unit, and how it is aligned with the previous B.Sc. course in Pharmacognosy and Natural Products Chemistry, and discusses aspects of students motivation and prior knowledge. It is concluded that the new curriculum structure may benefit by reducing the amount of material covered and simplifying student activites to leave (even more) room for student reflection. Nina Rønsteds final comment may serve as a bon mot for the anthology as a whole: "Just as students can, teachers can improve by practice".

Part I

Course structure analyses

2

Restrukturering af kurset ”Almen Husdyravl”

Birgitte Ask

Genetik og Bioinformatik, LIFE, Københavns Universitet

Kurset “Almen Husdyravl” er et valgfrit kursus på 3. år af Naturressource Bacheloruddannelsen til 7.5 ECTS point (8 uger), der henvender sig til studerende med specialisering indenfor husdyrvidenskab. Kurset har i 2009 fået en middelmådig studenterevaluering, og der var også flere overlappende kritikpunkter med året før. Som underviser på kurset i 2009 er der desuden identificeret et antal andre centrale problemstillinger for kursets alignment. Formålet med dette projekt er derfor at udarbejde en restrukturering af kurset “Almen Husdyravl”, som skal skabe “constructive alignment” i kurset samtidig med at de studerendes kritikpunkter og de af underviseren identificerede problemstillinger imødekommes.

Følgende studenterkritikpunkter (1) og underviser identificerede problemstillinger (2) vil blive adresseret:

1. Studenterkritikpunkter:
   a) undervisning i avlsteorien for komprimeret på kort tid samt for få øvelsestimer i relation til teorien.
   b) uhensigtsmæssig placering af dyreartsspecifikke forelæsninger i forhold til projektarbejde.
   c) varierende faglig og pædagogisk kvalitet af gæsteforelæsninger (nogle emner kun berørt i disse).
2. Underviserproblemstillinger:
   a) pensumbaseret undervisning samt utilstrækkelig overensstemmelse med målbeskrivelse.
   b) faldende antal af “traditionelle” studerende (fra naturressource studiet) med husdyrspecialisering.

c) studerendes manglende forståelse samt differentieret vejledning af det individuelle projektarbejde.

Metode

Projektet er udarbejdet ved en analyse af kursets nuværende struktur i forhold til kursusbeskrivelse, studenterevalueringer og resultater samt egne erfaringer med undervisningen på kurset. Analysen bestod i at opstille og besvare et antal spørgsmål med hensyn til målbeskrivelse, målgruppe, opbygning: pensum vs. outcome fokus, studenteraktiviteter og formativ og summativ evaluering vha. studenterevalueringen fra 2009 (Appendiks A), samt egne erfaringer og overvejelser på baggrund af undervisningen i 2009. Forslag til ændringer til forbedring af alle punkter behandlet i den indledende analyse er herefter blevet udarbejdet og præsenteret med tilhørende motivation og konkretiseringer via eksempler. I analysen vil bl.a. "constructive alignment"teori blive anvendt til at vurdere kurset. Dvs. ifølge såkaldt "constructivist theory", som omhandler de studerendes brug af egne aktiviteter til konstruktion af deres tilsigtede læringsmål, samt overensstemmelse (alignment) imellem målbeskrivelse, studenteraktiviteter og evaluering i undervisningen. Desuden vil målbeskrivelse, aktiviteter og evalueringer ifølge kursusbeskrivelse, -materiale og undervisers erfaring blive sammenholdt med både SOLO og Bloom's taxonomi (Biggs & Tang; 2007).

Målbeskrivelse

Den nuværende målbeskrivelse for Almen Husdyravl er angivet i kursusbeskrivelsen (se Appendiks B). Målene under "Viden" og især "Kompetencer" bredt formulerede. Når målbeskrivelsen er bred og dermed uspecifik besværliggør dette tilrettelæggelsen af undervisningen både med hensyn til kursets struktur, undervisningsaktiviteter og evaluering, da det ikke er muligt at observere, måle eller evaluere bredt formulerede learning outcomes (læringsresultater). Derfor bør målbeskrivelsen enten specificeres i højere grad, eller hvert af punkterne i målbeskrivelsen (dvs. hvert learning outcome) bør akkompagneres af et eller flere specifikke læringsmål. Læringsmål er nemlig specifikke hjælpere, der angiver små skridt i retning af opnåelsen af de formulerede learning outcomes (Manager; 2008). Målbeskrivelsen er i nogen grad funktionel; dvs. at den til dels beskriver, hvad de studerende

skal kunne gøre i en given situation (Byram; 2000; Biggs & Tang; 2007), da den anvender ord som at beskrive, beregne, analysere, fortolke, diskutere og vurdere. Kun to steder anvendes ordet forstå, som ikke er funktionelt. De anvendte funktionelle ord ligger på det multistrukturelle og relationelle niveau i SOLO taxonomien og falder under kategorierne "Forståelse", "Analysere" og "Evaluere" i Bloom's taxonomi (Biggs & Tang; 2007). I modsætning til bredden på målbeskrivelsen assisterer disse formuleringer derfor i tilpasningen af studenteraktiviteter og evalueringer til målbeskrivelsen. For at sikre en "constructive alignment" af kurset, dvs. at tilrettelægge opbygningen af undervisningen, undervisningsaktiviteter og evalueringen i overensstemmelse med målbeskrivelsen, bør kursets målbeskrivelse præciseres mere og desuden gøres fuldt funktionel. Dette kan desuden bidrage til at gøre undervisningen mere outcome-baseret. Et forslag til en ændring af målbeskrivelsen ses i figur 1 (for sammenligning med den nuværende målbeskrivelse se Appendiks C).

De første tre punkter under "Viden" er alle funktionelle målbeskrivelser, men de skal formuleres mere præcist. F.eks. kan punkt 1 under "Viden" blive mere specifik ved at præcisere 1) at det drejer sig om udbredelsen i både Danmark og på verdensplan, og 2) ordet produktionsniveau ved en ændring til individuelt præstationsniveau. Produktionsniveau kan nemlig både hentyde til individuel præstation såvel som populationsmæssige markedsstatistikker. Punkt 2 kan præciseres ved at anvende den terminologi, som også planlægges at anvendes i det nye kompendium til Almen Husdyravl, for ord, såsom avlsforanstaltninger, som er upræcise. Punkt 3 kan præciseres ved at specificere de faktorer, som det (minimum) ønskes, at de studerende skal kunne, f.eks.: genetisk variation, indavl, reproduktionskapacitet, avlsværdisikkerhed og -vurderingsmetode, og brug af genteknologi. Punktet kan desuden gøres yderligere funktionelt ved at ændre verbet beskrive til et andet SOLO eller Bloom taxonomi verbum, da dette verbum er ufunktionelt i denne sammenhæng: Skal man bare kunne nævne og måske definere faktorerne eller skal man også kunne forklare hvilken betydning de har for den avlsmæssige udvikling af en husdyrpopulation? Verbet forklare, som ligger på det relationelle niveau i SOLO taxonomien modsat beskrive, som ligger på det multistrukturelle niveau (Biggs & Tang; 2007), kan tydeliggøre meningen. Det fjerde punkt under "Viden" bør ændres både med hensyn til formuleringens funktionalitet og præcision, da det er både ufunktionelt (bruger verbet forstå) og uklart formuleret (f.eks. uklart på hvilket niveau sammenhængen skal forstås). Funktionaliteten kan igen øges ved at ændre verbet til forklare, og et forslag til en mere klar eller

Viden:

1. Beskrive udbredelse i Danmark og på verdensplan samt individuelt præstationsniveau af de vigtigste husdyrracer indenfor de produktionsmæssigt vigtigste husdyrarter i Danmark
2. Beskrive avlsprogram for de enkelte husdyrarter: herunder avlsmål, metoder til genetisk evaluering og genetiske parametre for vigtige egenskaber, struktur (registreringsstrategi, selektionstrin og parringsstrategi), og brug af reproduktions-/genteknologier.
3. Forklare hvad følgende begreber er, og hvilken betydning de har for den avlsmæssige udvikling af en husdyrpopulation: genetisk variation, heritabilitet, indavl, selektionsintensitet, avlsværdisikkerhed, avlsværdivurderings-metode og genetiske korrelationer.
4. Forklare sammenhængen mellem husdyrenes genetik, miljø og fænotypiske præstationer i en population.
5. Beskrive et simpelt avlsprogram til konservering af (husdyr-)genetiske ressourcer.

Færdigheder:

1. Beregne slægtskab, indavlsgrad, genetiske parametre, avlsværdi og heterosis for simple datasæt.
2. Beregne forventet genetisk fremgang for en given (husdyr-)population.

Kompetencer:

1. Uddybe en problemformulering over en problemstilling i relation til husdyravl eller konservering af (husdyr-)genetiske ressourcer.
2. Indsamle, analysere og fortolke videnskabelig information om et specifikt emne i relation til husdyravl eller konservering af (husdyr-)genetiske ressourcer.
3. Slettes.
4. Diskutere og vurdere effekten af forskellige indavlsrestriktionsstrategier, reproduktions- og genteknologier for konserveringen af (husdyr-)genetiske ressourcer.

Figur 2.1. Forslag til fremtidig målbeskrivelse for faget Almen Husdyravl.

præcis formulering er givet i Figur 2.1. Det er ikke nødvendigt at ændre målbeskrivelsen beskrevet under "Færdigheder", da den allerede er både funktionel og præcis. Punkterne 1, 2 og 4 beskrevet under "Kompetencer" er allerede funktionelle, men yderligere præcisering (Figur 2.1) kan give en endnu større funktionalitet. Det kan desuden diskuteres hvorvidt det er essentielt for kurset at de studerende selv identificerer en problemstilling.

Dette komplicerer en eventuel omlægning af kursusopbygningen, da det kræver et vist forhåndskendskab til avlsteori eller praktisk avl. Desuden giver det et unødigt tidspres både med hensyn til at beherske denne kompetence og med hensyn til det efterfølgende projektarbejde. I stedet kan de studerende præsenteres for en række mulige overordnede problemstillinger. Dette sker allerede nu, men man kunne vinde fleksibilitet i kursusopbygningen ved at fremtvinge et valg af problemstilling (evt. eget forslag) indenfor en meget kort tidsramme. En stimulering af de studerendes selvstændighed og følelse af ejerskab kan bibeholdes ved at de studerende stadig selv skal præcisere problemstillingen. I modsætning til punkt 1, 2 og 4 er punkt 3, beskrevet under "Kompetencer", hverken funktionelt eller præcist, men da det falder ind under punkt 3 under "Viden" og punkt 4 under "Kompetencer, anbefales det blot at fjerne det fra målbeskrivelsen.

Målgruppe

Kursets tilsigtede målgruppe er naturressourcestuderende med specialisering indenfor husdyrvidenskab, hvilket kursets målbeskrivelse i høj grad er fokuseret på. Af flere årsager bør kursets målbeskrivelse revurderes med henblik på også at inkludere f.eks. biologistuderende i målgruppen: reelt tager også biologistuderende kurset og der er et lavt antal naturressourcestuderende indenfor husdyrspecialiseringen. Biologistuderende skal tage kurser til et vist antal ECTS point på andre fakulteter end det Naturvidenskabelige og er dermed en realistisk del af målgruppen. Rent fagligt vil en sådan udbredelse af målgruppen være naturlig, idet dele af traditionelt biologiske fagområder, såsom populationsgenetik og evolutions- og forvaltningsbiologi, bliver en stadigt større integreret del af husdyravlen. Målbeskrivelsen bør så også ændres til at adressere de biologistuderende direkte. En sådan adressering er på nuværende tidspunkt implicit og kan forbedres ved at sørge for at inkludere emner med relevans for de biologistuderendes traditionelle virkeområder, såsom forvaltning af biodiversitet, naturlig selektion og konserveringsgenetik. I figur 2.1 er der givet forslag til en udvidelse af målbeskrivelsen med et punkt 5 under både "Viden" og "Kompetencer", som adresserer netop konserveringsgenetikken, der bør være tiltalende for biologistuderende. Desuden er punkt 1 og 2 under "Kompetencer" udvidet med separat specificering af husdyravl og konservering af (husdyr-)genetiske ressourcer, og husdyr er sat i parentes, hvor der også er relevans for f.eks. konservering af truede arter i zoologiske haver.

Opbygning: Pensum versus Outcome fokus

Kursets nuværende opbygning er pensumbaseret og følger en struktur, hvor al avlsteori gennemgås de første 3 af de 8 uger, og den anvendte husdyravl gennemgås i de efterfølgende 4 uger (uge 4-7). Det valgfrie, individuelle projekt indledes i starten af kursets 3. uge og afleveres i slutningen af kursets 7. uge (se Appendiks B). Dvs. at kurset følger en traditionel pensumbaseret struktur, hvor kurset og de studerendes fremgang er lærercentreret og måles via en tidsvariabel (Sullivan & McIntosh; 1995). Der er mindst to årsager til at den pensumbaserede struktur er bevaret indtil nu: 1) inddragelse af gæsteforelæsere og 2) den bagvedliggende tanke er at en gennemgang af teorien før de husdyrspecifikke emner sætter de studerende bedre i stand til at forstå de husdyrspecifikke emner (Mark; 2010). En kursusstruktur, der er pensumbaseret, fokuserer på at overføre viden, men vidensoverførsel er kun en lille del af den reelle indlæring (Agten; 2007). Især hvis den studerende rent faktisk skal være i stand til at bruge den viden, der er blevet overført, til noget konkret senere hen. Desuden kræver den pensumbaserede opbygning, at de studerende er i stand til at følge den tidsramme, som underviseren følger, og underviseren er, eller føler sig, ofte bundet af den udstukne tidsramme (Sullivan & McIntosh; 1995). Derfor bør kursusstrukturen ændres til at adressere et bredere spektrum af indlæring (dvs. til at inkludere f.eks. samarbejdsmæssig-, problemorienteret- og aktivitetsbaseret indlæring). Der skal selvfølgelig stadig være en klar struktur på og plan for kursets opbygning, og gæsteforelæsere skal stadig kunne inddrages, om end måske i et mindre omfang. En outcome-baseret kursusstruktur vil befordre et bredere spektrum af indlæring. Outcome-baseret undervisning og læring beskriver en situation, hvor tilsigtede resultater (outcomes) defineres så præcist som muligt, f.eks. kompetencebaserede undervisning, hvor resultater (outcomes) defineres i smalle kompetencer, såsom færdigheder (Biggs & Tang; 2007). En kompetencebaseret kursusstruktur giver de studerende øget selvtillid gennem succes med at opnå beherskelse af de smalt definerede kompetencer (Norton, 1987), hvilket igen giver øget motivation der stimulerer læringen (Biggs & Tang; 2007). Outcome-baseret undervisning og læring danner en basis for en studentercentreret undervisningsmodel, der tager udgangspunkt i hvad den studerende gør og hvor godt tilsigtede resultater opnås og ikke bare i principper, koncepter og fakta (Biggs & Tang; 2007). I figur 2.2 vises et forslag til en fremtidig outcome-baseret kursusstruktur for Almen Husdyravl, antagende at den samme blokstruktur bibeholdes.

Ugenr.	Dag og tid	Undervisningsresultat	Undervisningsform / Aktiviteter
1	Man 8-12	1) Beskrive undervisningsstruktur+ forventninger til studerende under+ efter kurset. 2) Forklare forskellige begreber (overfladisk) relateret til et avlsprogram, evt. vha. husdyrartsspecifikke eksempler. 3) Beskrive projektarbejdsmetode + grundlag for valg af emne til eget projekt.	Ad 1) Forelæsning m. evt. dialog. Ad 2) Forelæsning m. dialog. Lad studerende forklare begreber for hinanden. Ad 3) Dialog: strukturel sideløbende gennemgang af to gamle projekter (et ringe og et godt); hvad er godt og dårligt i (udsnit af) hvert afsnit af begge projekter og hvorfor.
	Tirs 13-17	1) Forklare hvad der forstås ved avlsmål og hvilken betydning avlsmålet har. 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. kvæg. 1) Beskrive og diskutere punkt 1 og 2 under "Kompetencer" i målbeskrivelsen.	Ad 1) Forelæsning m. dialog og diskussionsopgaver. Ad 2) Gæsteforelæsning m. dialog. Ad 1) Studerende præsenterer og diskuterer gamle projekter gruppevis.
	Fre 8-12	2) Emnevalg og gruppedannelse. 3) Punkt 1 og 2 under "Kompetencer" i målbeskrivelsen.	Ad 2) Emnevalg til individuelt projekt og grupper til selvhjælp dannes. Ad 3) Selvstændigt projektarbejde.
2	Man 8-12	Punkt 3 under "Viden" og 1 under "Færdigheder" i målbeskrivelsen.	Forelæsning om genetiske parametre + øvelser med diskussions- og regneopgaver.
	Tirs 13-17	Punkt 3 under "Viden" og 1 under "Færdigheder" i målbeskrivelsen.	Forelæsning om metoder til genetisk evaluering + øvelser med opgaver.
	Fre 8-12	Punkt 3 under "Viden" og 1 under "Færdigheder" i målbeskrivelsen.	Forelæsning om metoder til genetisk evaluering + øvelser med opgaver.
3	Man 8-12	1) Punkt 3 under "Viden" i målbeskrivelsen. 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. svin.	Ad 1) Forelæsning om registreringsstrategi+selektionstrin + øvelser m. diskussionsopgaver. Ad 2) Gæsteforelæsning m. dialog.
	Tirs 13-17	Punkt 3 under "Viden" og 1 under "Færdigheder" i målbeskrivelsen.	Forelæsning om parringsstrategier (indavl+heterosis) + øvelser med opgaver.
	Fre 8-12	Punkt 2 under "Viden" og 4 under "Kompetencer" i målbeskrivelsen.	Ekskursion: kvæg og svineavl m.m. (hele dagen). Foredrag, aktiviteter, diskussioner.
4	Man 8-12	Punkt 1 og 2 under "Kompetencer" og 1ste deadline problemformulering.	Selvstændigt projektarbejde og aflevering af problemformulering til medstuderende kl.12.
	Tirs 13-17	1) Beskrive og diskutere punkt 1 og 2 under "Kompetencer" i målbeskrivelsen. 2) Punkt 1 og 2 under "Kompetencer" i målbeskrivelsen.	Ad 1) Gruppevis feedback på problemformuleringer. Skriftlig feedback afleveres. Ad 2) Selvstændigt projektarbejde.
	Tors kl.12	2nden deadline problemformulering.	Aflevering af problemformulering til underviser kl.12.
	Fre 8-12	1) Punkt 3+5 under "Viden, 1 under "Færdigheder", 5 under "Kompetencer". 2) Punkt 1 under "Kompetencer" i målbeskrivelsen.	Ad 1) Forelæsning om indavl+konservering. + øvelser med diskussions- og regneopgaver. Ad 2) Feedback på problemformuleringer fra underviser kl.16.
5	Man 8-12	1) Punkt 3 under "Viden, 1 under "Færdigheder", 4+5 under "Kompetencer". 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. fjerkræ eller svin.	Ad 1) Forelæsning om heterosis + øvelser med diskussions- og regneopgaver. Ad 2) Gæsteforelæsning m. dialog.
	Tirs 13-17	Punkt 5 under "Viden og 5 under "Kompetencer" i målbeskrivelsen.	Ekskursion: zoologisk have – konservering. Foredrag, fremvisninger og diskussion.
	Fre 8-12	1) Punkt 3 under "Viden" og 2 under "Færdigheder" i målbeskrivelsen. 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. hest.	Ad 1) Forelæsning om genetisk fremgang + øvelser med diskussions- og regneopgaver. Ad 2) Gæsteforelæsning m. dialog.
6	Man 8-12	1) Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen. 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. fisk.	Ad 1) Selvstændigt projektarbejde. Ad 2) Gæsteforelæsning m. dialog.
	Tirs 13-17	1) Punkt 4 og 5 under "Kompetencer" i målbeskrivelsen. 2) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. mink.	Ad 1) Forelæsning om reproduktionsteknologier + øvelser med opgaver. Ad 2) Gæsteforelæsning m. dialog.
	Fre 8-12	Punkt 1 under "Færdigheder" og 4+5 under "Kompetencer" i målbeskrivelsen.	Forelæsning om MAS og genomisk selektion + øvelser med diskussions- og regneopgaver.
7	Man 8-12	1) Punkt 1 og 2 under "Viden" i målbeskrivelsen for f.eks. får. 2) Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen.	Ad 1) Gæsteforelæsning m. dialog. Ad 2) Selvstændigt projektarbejde.
	Tirs 13-17	1) Punkt 4 under "Kompetencer" i målbeskrivelsen. 2) Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen.	Ad 1) Undervisenstyret dialog +gruppediskussioner om effekt af ændringer på avlsprogram. Ad 2) Selvstændigt projektarbejde.
	Fre 8-12	1) Punkt 5 under "Kompetencer" i målbeskrivelsen. 2) Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen.	Ad 1) Undervisenstyret dialog og/eller gruppediskussioner om konserveringsstrategier. Ad 2) Selvstændigt projektarbejde.
8	Man 8-12	Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen.	Selvstændigt projektarbejde.
	Tirs 13-17	Punkt 2 og 4 eller 5 under "Kompetencer" i målbeskrivelsen. Deadline projekt.	Selvstændigt projektarbejde og aflevering af projekt til underviser kl.17.
	Fre 8-12	Mundtlig kursusevaluering, spørgetime og information om eksamen.	-

Figur 2.2. Forslag til fremtidig kursusstruktur med outcome-baseret undervisning for Almen Husdyravl

Den foreslåede outcome-baserede undervisningsstruktur tager udgangspunkt i målbeskrivelsen, især punkterne under "Kompetencer" vist i figur 2.1, hvorved også kritikpunkt 2a imødekommes. Det er tanken, at de første to punkter under "Kompetencer" udvikles gennem det individuelle projektarbejde, mens adresseringen af de sidste to punkter under "Kompetencer" tager udgangspunkt i avlsprogrammer (traditionelle eller konserverings). Forslaget til kursets struktur er derfor bygget op omkring det individuelle projekt samt avlsprogrammer, hvor de studerende først introduceres til den overordnede struktur af et avlsprogram og derefter dykker ned i underdelene én for én. Til opnåelse af de to første punkter under "Viden" i målbeskrivelsen, foreslås det, at de enkelte husdyrarter løbende inddrages til eksemplificering af teorien, og at gæsteforelæsere for så vidt muligt inviteres til at give mindre introer (dvs. mindre omfattende end i den nuværende form) til den praktiske avl indenfor de respektive arter fordelt henover kursusperioden. Der er risiko for, at dette stadig vil medføre utilfredshed blandt studerende, som skriver projektet indenfor en dyreart, for hvilken avlspraksis først introduceres i slutningen af kurset. Større problemer bør dog kunne forebygges med en kombination af det planlagte nye forbedrede og ajourførte kompendium samt ved løbende inddragelse af husdyrartsspecifikke eksempler gennem hele kurset. Desuden kan vil en reducering i omfanget af gæsteforelæsningerne mindske afhængigheden af disse i gennemgangen af det faglige stof, samtidig med at man bibeholder det friske pust fra "virkelighedens verden", hvilket imødekommer kritikpunkt 1c. En fordeling af introerne til den praktiske avl givet af gæsteforelæserne imødekommer desuden de studerendes kritikpunkt 1a og 1b. Strukturen af det individuelle projektarbejde kan forbedres ved at ændre på vejledningsformen. F.eks. kan fokus ændres til at opstille en problemformulering, i stedet for identificere en relevant problemstilling. Dette opnås ved at fremtvinge et hurtigt emnevalg med en deadline, som tidligere nævnt, men også ved at fokusere mere på projektet i undervisningen før denne deadline, således at undervisningen danner et forum for stillingtagen til netop emnevalget (se Figur 2.2, ugenr. 1).

Studenteraktiviteter

Kursets hidtidige studenteraktiviteter inkluderer opgaveregning (skriftlige og computerbaserede), hovedsageligt i dertil allokerede øvelsestimer, to ekskursioner (en heldags om traditionel husdyravl og en kortere om be-

varelse af små populationer) samt individuelt projektarbejde. Opgaveregningen adresserer "Færdighederne" i kursets målbeskrivelse, men adresserer kun i lav grad "Kompetencerne". Ekskursionerne er inkluderet for at tilføre konkretisering af kursets teori på en vedkommende og interessant måde, for at øge de studerendes forståelse og motivering. Det individuelle projektarbejde er inkluderet, da de studerende erfaringsmæssigt lærer bedre, hvis de aktivt skal formulere og sortere i informationen i det faglige stof samt lave udledninger baseret på dette. Projektarbejdet adresserer især "Kompetencerne" i kursets målbeskrivelse. Bortset fra de punkter, der nævnes under "Viden", burde studenteraktiviteterne derfor principielt kunne støtte rimeligt op om kursets målbeskrivelse (i alignment). De studerende er generelt positive overfor studenteraktiviteterne, men især den strukturelle tilrettelægning med hensyn til overensstemmelse mellem aktiviteter og læringsmål kan dog med fordel forbedres og projektarbejdet har fået varierende kritik med hensyn til metode forståelse og krav til indhold (se Appendiks C). Aktiviteterne understøtter desuden ikke fuldt ud opnåelsen af "Kompetencer" i målbeskrivelsen. Øvelsestimernes form og gennemgangen af diskussionsopgaver bør ændres for at opnå en højere grad af adressering af målbeskrivelsen. I den nuværende form arbejder de studerende i øvelsestimerne individuelt eller parvis efter eget ønske. Opgaverne udleveres i starten af øvelsestimerne, og skriftlige svar lægges på katederet, så de studerende kan hente svarene efter forgodtbefindende. Underviseren hjælper de studerende efter behov. Forståelse og indlæring kunne øges ved at 1) reflektere over resultaterne i fællesskab (evt. indledningsvist parvis indbyrdes mellem de studerende – summegrupper), og 2) gennemgå diskussionsopgaver i fællesskab efter indledningsvis parvis diskussion mellem de studerende (summegrupper). Et eksempel på en regneopgave, hvor der bør reflekteres i fællesskab, ses her:

Opgave 7: Genetisk Fremgang og Heritabilitet:
Følgende observationer foreligger fra et selektionsforsøg for godt 100 tilfældigt udvalgte grise:

Gns. vægt, 5 mdr, population = 88,5 kg
Gns. vægt, selekterede gylte = 93,0 kg
Gns. vægt, selekterede orner = 102,0 kg
Gns. vægt, afkom = 89,5 kg

1. Beregn den gennemsnitlige genetiske fremgang for en generation
2. Beregn heritabiliteten

I opgavens nuværende form kan de studerende beregne resultaterne ud fra simple formler, som vil være at finde i det nye Kompendium. Der er

altså risiko for at de ikke reflekterer over resultatet og dermed ikke lærer meget andet end at bruge formlerne korrekt. Dette er selvfølgelig også en del af målet med punkt 1 og 2 under "Færdigheder" i målbeskrivelsen, men fuldt udbytte (adressering af flere punkter under både "Viden" og "Kompetencer") kan kun opnås ved også at reflektere over resultaterne. Eksempler på spørgsmål man kunne stille de studerende som underviser er:

- "Kan vi forvente denne genetiske fremgang i hver generation herefter og hvorfor/hvorfor ikke?"
- "Er dette en høj eller lav heritabilitet?"
- "Er dette en realistisk heritabilitet i forhold til forventningen for denne egenskab hos grise?"
- "Hvilke faktorer kunne medvirke til en anden heritabilitet end forventet?"

Tekst i Vejledning til projekter 2009: "Projektet skal indeholde"	Forslag til ændring/udvidelse af tekst
Indledning (inkl. problemformulering/formål og afgrænsning; max 1 side)	Bør kort inkludere punkt 1 og 2 under "Viden" i målbeskrivelsen for den pågældende dyreart behandlet i projektet. Bør desuden adressere punkt 1 under "Kompetencer" i målbeskrivelsen, dvs. lede frem til identificering af en relevant problemstilling i relation til husdyravl eller konservering og formål for det pågældende projekt.
Metode (max ½ side; evt. afsnit under indledning)	Bør beskrive hvilken fremgangsmåde, der benyttes til at belyse den identificerede problemstilling. Herunder hvilke underliggende spørgsmål, der forsøges besvaret til hjælp ved afklaring af projektets formål, og ved belysning/diskussion af hvilke emner dette gøres.
Litteratur review og diskussion (max 8 sider; evt. som separate afsnit)	Litteratur review, eksemplificering og diskussion. Bør afdække/opsummere eksisterende information om relevante emner vha. litteratur og herved demonstrere opfyldelse af punkt 2 under "Kompetencer i målbeskrivelsen. Bør desuden inkludere en for formålet relevant eksemplificering, der udmundes i et regnestykke, ved at bruge tal fra litteraturen (eller evt. fiktive tal), der adresserer en eller flere færdigheder i punkt 1 og 2 under "Færdigheder" i målbeskrivelsen. Bør herudover også inkludere en opsamlende og perspektiverende diskussion, der adressere punkt 4 eller 5 under "Kompetencer" i målbeskrivelsen.

Figur 2.3. Forslag til ændringer i vejledningen af individuelle projekter (Vejledning til projekter 2009 i Appendiks D).

Det individuelle projekt bør forbedres ved bl.a. at introducere projektskrivningsmetoden grundigere og tydeliggøre forventningerne til projektets form og niveau yderligere. Følgende tiltag kunne f.eks. benyttes: A) lave en sideløbende gennemgang af to projekter af henholdsvis ringe og god kvalitet i dialog med de studerende (se figur 2.2, ugenr. 1, Man 8-12, pkt. 3) med hensyn til hvad der fungerer godt og dårligt og hvorfor; og B) lade de studerende selv præsentere og diskutere et antal gamle projekter gruppevis (se figur 2.2, ugenr. 1, Fre 8-12, pkt. 1). Desuden bør retningslinierne med hensyn til projektets indhold tydeliggøres yderligere for at sikre at flere

studerende når flere mål i målbeskrivelsen i højere grad end nu. Dette kan gøres ved at specificere både i det skriftlige projektmateriale (se figur 2.3 og Appendiks D) og mundtligt under introduktionen til projekterne, hvilke dele af målbeskrivelsen de studerende bør forsøge at opfylde i de forskellige afsnit af projektet. F.eks. bør alle projekter indeholde et relevant regnestykke, der adresserer punkterne 1 og 2 under "Færdigheder" i målbeskrivelsen (se figure 2.1).

Ekskursion - Besøgssted	Spørgsmål til refleksion eller diskussion
Eksteriørbedømmelse	- Hvad er formålet med eksteriørbedømmelsen (er det en del af avlsmålet og hvorfor)? - Hvornår / hvor ofte eksteriørbedømmes køerne, og hvilken betydning har dette for avlsværdivurderingen? - Hvordan er eksteriøregenskaberne defineret, og hvilken betydning har dette for avlsværdivurderingen?
Afprøvningsstation for svin	- Hvorfor afprøves svinene på station (hvilke fordele og ulemper er der ved dette)? - Hvilke egenskaber registreres og hvordan?
Kvægavlsforening	- Hvad er fordele og ulemper ved kønssorteret sæd? - Hvilke anbefalinger giver kvægavlsforeningen avlerne mht. kønssorteret sæd og hvorfor? - Hvilke praktiske komplikationer findes der i forbindelse med den genomiske avlsværdivurdering og implementeringen heraf?
Zoologisk Have	- Hvilke indavlsrestriktioner bruges af zoologiske haver i deres konserverings-avlsprogrammer? - Hvordan omgås der med dyr med ukendt afstamning, f.eks. dyr indfanget i naturen) i konserveringsavlsprogrammer? - Forventes den genetiske sammensætning af bestande i zoologiske haver at forblive iden-tiske med vilde bestande, hvis eneste "avlsmål" er en indavlsrestriktion? Hvorfor (ikke)?

Figur 2.4. Eksempler på spørgsmål til de studerende for at stimulere refleksion under ekskursionen eller til diskussion efter hvert besøgssted / ekskursionen.

Ekskursionerne bør tilrettelægges til at øge det faglige udbytte samt tage højde for en bredere målgruppe. For at øge det faglige udbytte kan diskussionerne ledes mere af underviseren og de studerende kan stimuleres til på forhånd at være bedre forberedt på diskussioner. F.eks. kan det indføres at de studerende gruppevis forbereder et antal spørgsmål til hvert besøgssted, som så kan bruges som tjekliste under ekskursionen. Alternativt kan underviseren give de studerende en række spørgsmål til refleksion under ekskursionen, som man løbende kan henvise til. Ligeledes kan underviseren efter ekskursionerne udfordre de studerende med en række spørgsmål vedrørende berørte emner på de forskellige forsøgssteder (se figur 2.4). Hvis de studerende på forhånd er klar over at de kan få sådanne spørgsmål, stimuleres de måske til at være mere aktive og fokuserede på relevante avlsspørgsmål i stedet for f.eks. etiske problemstillinger under ekskursionerne.

Formativ og Summativ Evaluering

Kursets nuværende evaluering består i en summativ evaluering af det individuelle skriftlige projektresultat, der vægter med 50% i slutkarakteren, samt en individuel mundtlig eksamination á 30 min. varighed (summativ evaluering). Til den mundtlige eksamination skal den studerende indledningsvist præsentere projektet, hvorefter spørgsmål tager udgangspunkt i det skriftlige projektarbejde, men i princippet kan spænde over hele pensum. Desuden er der indlagt en frivillig individuel formativ evaluering, hvor underviseren giver feedback på projektets problemformulering. Udover denne strukturerede formative evaluering, kan de studerende løbende stille spørgsmål til underviserne enten efter klasse undervisningen, per email eller ved at komme forbi undervisernes kontorer. Den nuværende evalueringsform tillader principielt evaluering af alle punkter i kursets målbeskrivelse, da de fleste punkter under "Viden" og "Kompetencer" kan testes både i det skriftlige projektarbejde og til den mundtlige eksamen, mens "Færdigheder" kan testes i det skriftlige projektarbejde. Da valget af problemstilling til projektet og selve projektarbejdet er individuelt og meget fritstillet, er der dog stor variation på hvorvidt der inkluderes beregninger i projektet og "Færdigheder" dermed testes. Den lave mængde af formativ evaluering er desuden ikke befordrende for udviklingen af målbeskrivelsens "Kompetencer" og mere formativ evaluering kan bidrage til bedre forståelse af projektarbejdet. En udvidelse af den formative evaluering af projektarbejdet kunne f.eks. bestå i en indbyrdes formativ evaluering imellem de studerende som en del af projektarbejdet (se figur 2.2, ugenr. 4, undervisningsform/ aktiviteter). F.eks. ved at danne grupper med 3-4 studerende, hvori hver af de studerende afleverer et udkast til problemformuleringen til de andre gruppemedlemmer, som de derefter indbyrdes kan give feedback på (evt. både mundtligt i gruppesammenhæng og skriftligt). Mundtlig feedback kan skabe en diskussion omkring hver enkelt problemformulering, mens den skriftlige feedback kan bidrage til konstruktivitet og grundighed. Den skriftlige feedback kan evt. afleveres til underviseren, selvom dette selvfølgelig vil koste underviseren ekstra arbejde med at gennemse både problemformulering og studenter feedback for samtlige studerende. Alt i alt kan den studenterstyrede formative evaluering udnytte de studerendes mangfoldighed i viden, erfaring og synspunkter. Diskussioner de studerende imellem omkring problemformuleringen kan hjælpe de studerende til at reflektere over deres egen problemformulering både via spørgsmål og idéer fra de medstuderende, men også via reflektioner over de andre studerendes problemformulerin-

ger. Kun ca. halvdelen af de studerende afleverede en problemformulering til feedback fra underviseren i 2009, hvilket kunne skyldes faktorer såsom problemer med både identificering og opstilling af problemformuleringen samt tidspres eller mangelfuld evne til at administrere tiden. En indførsel af indbyrdes feedback de studerende imellem kan måske motivere de studerende til at komme i gang med problemformuleringen i tide til at aflevere og modtage feedback. Alternativt kunne man arrangere en undervisningsaktivitet med fremlæggelse af problemformuleringerne og derved både stimulere / fremtvinge en slags deadline på problemformuleringerne og danne et naturligt forum for diskussion af mulige forbedringer af hver enkelt problemformulering. Dette er dog igen en mere lærestyret form for undervisning, med risiko for at fratage de studerende følelsen af ansvar og ekstra tid og arbejde for underviseren. Den nuværende meget frie form for ekstra vejledning, der består i, at de studerende kan komme forbi undervisernes kontorer eller sende emails vedrørende spørgsmål til projektarbejdet, bærer risici med sig. For det første er der risiko for at vejledningen af de studerende bliver meget differentieret med de svage studerende som mulige tabere, og for det andet kan fleksible vejledningstider ende i et enormt arbejdspres (eller uhensigtsmæssig arbejdsplanlægning) for underviseren, hvis de studerende kommer rendende i tide og utide. Det foreslås derfor at omlægge denne vejledningsform til en mere struktureret form, hvor faste tider til vejledning indbygges enten i forbindelse med øvelsestimer eller udenfor den skemalagte undervisning. Tider i forbindelse med øvelsestimer er at foretrække, da tider i forbindelse med øvelsestimer bl.a. kan gøre det mindre grænseoverskridende for generte/beskedne studerende at bede om vejledning. Herved undgås også at studerende udnytter, at der er flere undervisere på kurset, som var tilfældet i 2009, hvilket er et unødigt arbejdspres på underviserne. Hvis vejledningen ikke placeres i forbindelse med øvelsestimer, kan dette forebygges ved at tildele hver af de studerende en specifik underviser som vejleder, f.eks. afhængigt af emnevalg til projektet. Til slut, kunne inklusion af endnu et element af formativ evaluering, nemlig dannelsen af såkaldte "grupper til selvhjælp" eller en slags læsegrupper, f.eks. afhængigt af emnevalg til projektet, også være nyttigt for læringen. Hjælp til dannelsen af sådanne grupper kan stimulere de studerende til at bruge hinanden til hjælp med øvrige basale projektrelaterede aktiviteter, såsom f.eks. litteratursøgning. Derved minimeres arbejdspresset på undervisere, samtidig med at de studerendes læringsproces udvides fra kun at involvere deres eget projekt til også at inkludere andre projekter. Derved opnås både fordelene ved individuelt projektarbejde (stimulerer selvstændig læring og reflektion

over fagets indhold og simplificerer individuel evaluering) og fordelene ved gruppearbejde (de studerende kan udnytte hinandens stærke sider, og derved løfte det enkelte individs niveau).

Opsummering

Formålet med dette projekt var at udarbejde en restrukturering af kurset "Almen Husdyravl", som skal skabe "constructive alignment" i kurset samtidig med at kritikpunkter fremstillet af de studerendes og problemstillinger identificeret af underviseren imødekommes. Der er givet forslag til ændringer i målbeskrivelsen, målgruppen, kursets struktur, studenteraktiviteter og evaluering for at skabe en "constructive alignment" af kurset. Målbeskrivelsen er revideret med henblik på at gøre den funktionel og præcis for at lette constructive alignment af hele kurset og for at imødekomme en ændring i kursets målgruppe til udover naturressourcestuderende også at inkludere biologistuderende. Kursets struktur er revideret med henblik på at stimulere en outcome-baseret undervisning og læring, der sikrer en mindre komprimeret gennemgang af teorien og undgår afhængighed af at gæsteforelæsere berører bestemte emner, hvorved også placeringen af gæsteforelæsningerne bliver mindre kritisk. Kursets struktur er revideret med udgangspunkt i den ændrede målbeskrivelse, hvorved en constructive alignment af målbeskrivelse og studenteraktiviteter fremtvinges. Der er desuden givet forslag til udvidelse, forbedringer og ændringer af studenteraktiviteter, som skal sikre constructive alignment af målbeskrivelse og studenteraktiviteter. Iblandt forslagene til ændringer i studenteraktiviteter er en større fokus på refleksion over (regne-)opgaver og ekskursioner samt et mere standardiseret indhold af de individuelle projekter. Til slut er der givet forslag til en udvidelse og ændring af den formative evalueringsform i kurset med mere involvering af de studerende selv.

A Undervisningsplan for Almen Husdyravl 2009

Dato	Tid	Emner
Man. 31/8	8:30-12:00	Introduktion til kurset og projektarbejde, introduktion til avl, registrering af egenskaber, kvantitativ genetik, mendelsk udspaltning, heritabilitet, genetisk korrelation
Tirs. 1/9	13.00-14.00	Genetisk slægtskab
	14.00-16.30	Øvelser
Fre. 4/9	8.00-10.55	Avlsværdi, avlsværdivurering
	11.05-12.00	Øvelser
Man. 7/9	8.30-12.00	Selektion, genetisk fremgang, genetisk korrelation, korreleret respons, genotype x miljø vekselvirkning
Tirs. 8/9	13.00-16.30	Øvelser
Fre. 11/9	8.00-10.55	Avlsplanlægning, indavl, krydsning
	11.05-12.00	Øvelser
Man. 14/9	8.00-11.00	Genetiske tests, genomisk avlsværdivurdering, markør assisteret selektion
	11.00-12.00	Selvstændigt projektarbejde
Tirs. 15/9	13.00-14.30	Selektionsindeks
	14.30-16.30	Øvelser
Fre. 18/9	**6.00-23.00**	**Ekskursion til Jylland**
Man 21/9	9.00-12.00	Svineavl
Tirs. 22/9	13.00-17.00	Selvstændigt projektarbejde
Fre. 25/9	8.00-9.00	Etik i husdyravlen
	9.15-12.00	Avl i små populationer, bevarelse af husdyrgenetiske ressourcer, samarbejde ml. populationer, hunde- og katteavl
Man 28/9	8.00-12.00	Selvstændigt projektarbejde
Tirs. 29/9	13.00-15.00	Ekskursion til Københavns Zoologiske Have
	15.00-17.00	Selvstændigt projektarbejde
Fre. 2/10	8.30-?	Kvægavl
	?-12.00	Selvstændigt projektarbejde
Man. 5/10	9.00-12.00	Fjerkræavl
Tirs. 6/10	13.00-17.00	Selvstændigt projektarbejde
Fre. 9/10	8.00-10.55	Mink- og fiskeavl
	11.00-12.00	Selvstændigt projektarbejde
Man. 12/10	9.00-12.00	Fåreavl
Tirs. 13/10	13.00-17.00	Selvstændigt projektarbejde
Tors. 15/10	12.00	Deadline for aflevering af projekter
Fre. 16/10	8.00-10.55	Hesteavl
	11.05-12.00	Mundtlig kursusevaluering og information om eksamen
Uge 43		Forberedelse til eksamen
Uge 44		Eksamensuge

B Uddrag af kursusbeskrivelse for Almen Husdyravl 2009

Målbeskrivelse:

Det forventes at den studerende efter kurset kan:

Viden:
- beskrive de enkelte husdyrracers udbredelse og produktionsniveau
- beskrive avlsmål, avlsforanstaltninger, systemer til avlsværdivurdering samt avlsstruktur og avlsplanlægning for de enkelte husdyrarter
- beskrive hvilke faktorer der har betydning for avlsmæssig udvikling af en husdyrpopulation
- forstå sammenhængen mellem husdyrenes genetik og fænotypiske præstationer

Færdigheder:
- beregne slægtskab, indavlsgrad, genetiske parametre, avlsværdi og heterosis for simple datasæt
- beregne forventet genetisk fremgang for en husdyrpopulation

Kompetencer:
- opstille en relevant problemformulering i relation til husdyravl
- indsamle, analysere og fortolke relevant viden om et specifikt emne i relation til husdyravl
- forstå de overordnede teoretiske forudsætninger for husdyravl og den praktiske husdyravls problemstillinger og gennemførelse
- diskutere og vurdere effekten af forskellige avlsmæssige tiltag i en husdyrpopulation på baggrund af en evaluering af avlsmålsætning, avlsforanstaltninger, udvælgelsesstrategi og avlsstruktur

C Slutevaluering Almen Husdyravl 2009

- Personlig arbejdsindsats i kurset,
  inklusiv undervisning, i forhold til kursets normering: Tilpas: 100%
- I forhold til mine egne forudsætninger
  oplevede jeg det faglige niveau som værende: Tilpas: 57%; tilpas-for højt: 29%; for højt: 14%
- Jeg fik en god introduktion til kurset: Lidt uenig: 29%, neutral: 29%; lidt enig: 29%; helt enig: 13%
- Jeg synes, at kursusaktiviteterne støttede opnåelsen
  af de kompetencer, der fremgår af kursusbeskrivelsen: Lidt uenig: 17%; neutral: 50%; lidt enig: 33%
- Jeg mener, at undervisningsforløbet lagde op
  til min aktive deltagelse: Lidt uenig: 14%; neutral: 43%; lidt enig: 43%
- Jeg har fået et udbytte, der svarer til min indsats: Lidt uenig: 29%; neutral: 29%; lidt enig: 42%
- Jeg synes samlet set, at kurset var godt: Lidt uenig: 14%; neutral: 43%; lidt enig: 43%

Øvrige kommentarer:

Hvad fungerede godt ved kurset? Og hvad var grunden?

- Ekskursionerne var rigtig gode og seriøse - Jeg fik stort udbytte. Dog var det surt vi kom for sent til eksteriørundersøgelse. Det kunne jeg godt have brugt langt mere tid på.
- Turen til Jylland er helt klart min favorit ting på kurset da jeg fik et godt indblik i hvordan nutidens kvægbesætninger er indrettet, med staldforhold, avlsmål mm. Meget interessant og anderledes undervisning, som blier siddende, da man fysisk har set tingene og derfor nemmere kan forholde sig til dem.
- En anden god ting ved kurset er opgaven/projektet der fylder 50%
- Jeg synes det er en VIRKELIG god øvelse, inden vi giver os i kast med en bachelor opgave, og jeg har fået en masse ting med mig, som jeg ved jeg skal være opmærksom på ikke skal gentage sig ved bacheloropgaven. deriblandt, prioritering, samt computer håndtering mm.
- God planlægning og struktur. Dejligt at alt fra starten lå fast, så man kunne planlægge efter det.
- Godt med en tur ud i det virkelige liv! Godt med mange gode eksterne forelæsere.
- Projektet fungere rigtig godt fordi man kan få lov til at arbejde ekstra med noget der har ens interesse. Det er yderligere rat at have projektet at tage udgangspunkt i til eksamen.
- Godt med ekskursioner, også fint at der er andre undervisere ind over de forskellige dyregrupper.
- Det er rigtig godt at der veksles mellem forelæsning og øvelser
- Turen til Jylland var rigtig god. At Birgitte havde små opgaver med i sine forelæsninger var en god måde at få hos til at holde fokus. Godt med regnetimer så vi selv kunne afprøve formlerne. Synes det var rart at vi fik gennemgået de forskellige produktionsdyr, men rart, hvis vi havde været alle igennem før projektaflevering.

Jeg vil foreslå følgende forbedringer:

- Nyt lærebogsmateriale. Evt. tilføjelse af kompendium med regnemetoder osv.
- Desuden ville det være rart at underviserne, bare én, var til stede når der var projektarbejde så man har hurtigere måde at få besvaret lettere spørgsmål end at skulle aftale møde eller lave email korrespondance.
- Undervisningen var overordnet okay, men det overordnet udbytte fra hver forelæsning var meget minimal, primært grundet de ekstremt mange slides - der skabte lettere forvirring, da man ikke helt vidste hvad der var vigtig og hvad der kun var eksempler?
- Måske et kompendium med formlerne defineret + eksempler på regneopgaver samlet under et og samme sæt, kunne hjælpe den studerende med at få mere overblik, da der er mange formler, og mange faktorer der skal tages med i betragtning, og som let kan blive forvirrende at holde styr på.
- Bedre struktur på forelæsningerne fra de faste undervisere. Bedre opdelingen af indholdet i kapitel 1. Bedre struktur især på forelæsningerne de første 3 uger. Forslag: slide 1: Hvad skal vi lave i dag; 5 sidste slide: OPSAMLING over det vigtigste
- Meget vigtigt med bedre struktur på slidesene! Især de vigtige med formler. Hvad bruger vi formlerne til, hvad betyder de, hvad betyder de forskellige ting.
- Nyt kompendium. Det grundlæggende der bruges tid på de første 3 uger skal være mere spredt ud over forløbet fordi det virker som om det er det centrale som er vigtigt at forstå. De andre forelæsninger kan ligge hvor det passer ind fordi det overordnet ikke er så svært at forstå.
- Det ville være rigtig godt med en anden bog, eller et kompendium som beskriver teorien bedre og inddrager eksempler som medvirker til en bedre forståelse.
- Der er mange formler at holde styr på, en form for formelsamling kunne gøre det mere overskueligt.
- Et mindre antal slides, og mere overskuelige. De er svære at bruge som noter efterfølgende.

D Uddrag af vejledning til projekter 2009

Projektet skal indeholde:
Titel på projektet samt navn og studienummer for studerende
Sammendrag (eller ”abstract”; max ½ A4 side)
Indledning (inkl. problemformulering/formål og afgrænsning; max 1 side)
Metode (max ½ side; evt. afsnit under indledning)
Litteratur review og diskussion (max 8 sider; evt. som separate afsnit)
Konklusion (max ¼ side)
Reference liste
Tabeller og figurer tæller med i det samlede sideantal. Årsagen til at der er angivet øvre grænser for hvor meget de enkelte afsnit må fylde er at i skal tilskyndes til at skrive kort og præcist (og dermed udvikle jeres evne til at fokusere på det vigtigste og komprimere en stor mængde information om et fagligt emne til en konkret og sammenhængende rapport). Der kan ikke dispenseres fra de angivne max sidetal (bortset fra hvis projektet skrives i en gruppe; se nedenfor).

Gode råd og bemærkninger i øvrigt:

- Rapporten skal ikke dække hele pensummet
- Emnet skrives indenfor ”husdyravl” og rapporten skal derfor fokusere på genetiske aspekter frem for fænotypiske
- Start i god tid; det kan tage lang tid at indsamle relevant viden og finde frem til en relevant problemformulering. De fleste behøver også en del tid til selve skrive-processen
- Prøv at finde en konkret problemformulering, som er tydeligt afgrænset. Det er meget svært at komme ordentlig i dybden med den tid i har til rådighed, hvis I vælger et bredt og overordnet emne. I kan fx vælge blot at se på avlsmæssige aspekter af en enkelt egenskab og/eller en enkelt race/dyreart
- Selvom I har valgt at fokusere på en enkelt dyreart (eller race) kan det nogle gange (fx hvis resultater i litteraturen er begrænsede) være en fordel at kritisk sammenholde med resultater fra andre dyrearter (eller racer)
- Hold hele tiden fokus. Sørg for at indledningen ikke har blinde sidespor, men fører frem til en logisk og velbegrundet problemformulering (relevante sidespor kan nævnes i afgrænsningen). Sørg herefter for at alt i rapporterne er relevant i forhold til problemformuleringen og at konklusionen giver et præcist svar på problemformuleringen.
- Ofte er det nødvendigt at justere problemformuleringen (samt øvrige afsnit) i løbet af processen
- Metodeafsnittet indeholder en kort beskrivelse af fremgangsmåden der er benyttet til at belyse problemstillingen
- I diskussionsafsnittet sammenholdes resultater fra litteraturen i relation til problemformuleringen. Her kan egne synspunkter fremføres så længe det klart fremgår at det er egne synspunkter og de er velbegrundede.
- Nogle er bedre til at skrive kort og præcist end andre, men alle kan sikkert blive bedre. Når du synes projektet er ved at være færdigt er det ofte en god idé at gå alle afsnit grundigt igennem endnu engang, præcisere sætninger og skære det bort som ikke er absolut nødvendigt (dvs. det som ikke hjælper læseren med at komme fra problemformulering til konklusion). Projektet bliver oftest meget bedre efter denne proces.
- Når rapporten er afleveret kan i ikke opdatere mere, men i er meget velkomne til, i forbindelse med eksamen, indledningsvis at oplyse om fejl i projektet samt inddrage yderligere information som er relevante for jeres problemstilling. Dermed betyder eventuelle fejl og mangler i det afleverede projekt mindre for den samlede karakter end hvis I ikke selv gør rede for dem.

3

From chaos to order – redefining and clarifying student project assignments.

Charlotte Helgstrand

Department of Medicinal Chemistry, Faculty of Pharmaceutical sciences, University of Copenhagen

Background

In the autumn of 2009 I started as a new teacher in the course "Philosophy of Science" (3 ECTS) within the Bachelor programme in Pharmacy at Copenhagen University. This was a new challenge for me since I knew nothing about the subject and had no background in philosophy. On the other hand it was an excellent opportunity to see the course from the students' point of view since we started off with the same background knowledge.

The course has a theoretical base of 6·45 minutes lectures – that includes all practical information about the course, some history of science, some major movements in philosophy of science and more detailed lecturing on evidence based medicine. The major part of the course credits come from project work in groups; the students work on projects that should ideally illustrate concepts from the theory and deepen their understanding of the subject. To add relevance and interest for the students, the project assignments are based mostly on pharmaceuticals – cases where there had been controversies, withdrawals or historical development. The exam consists off a group presentation of the project and opposition (reading and posing questions) to another groups report. There are no marks given, only pass/fail, and by tradition noone that has put effort into the group work fails the course.

Before, during and after the course, there were several things I was dissatisfied with as a new teacher and most of them coincide with what the students point out as problem areas: There was a book for the course

– but there was not much correlation between the book, the lectures and the project work. I myself had to rely on other books and the internet to get a clear picture of the philosophical concepts. The students had similar complaints, and they felt that since they had to buy a book the course should follow it more closely.

As a project supervisor I was responsible for setting up a project portfolio of articles and define a set of questions that should guide the project work. It was never stated what the learning outcome of these projects should be or what should be covered – in the end I borrowed some old reports from another teacher to work out the assignments. Since six teachers set up six different portfolios with accompanying questions, the students experienced very different assignments and, depending on the subject, only parts of the theory could be covered.

The students also suffered from not having clearly stated learning goals. The project supervision was aimed at process guidance rather then helping the students to find answers – and most assignments were relatively open. Some of the students expressed frustration over the lack of guidelines and they felt that they didn't know what was expected of them. There was an "unofficial" list of concepts to be covered circulated among the teachers, but this was not to be shared with the students!

The course responsibility have been passed around the different institutes in the faculty several times the last few years, and there is a continuous inflow of new teachers (postdocs on temporary contracts). Despite this, the teacher group is enthusiastic and continuously tries to improve the teaching. But the problems persist, the course as a whole, and in particular the project assignments, lacks focus and clearly stated learning outcomes. As a result the students perceive the course as vague and unstructured. Since there is no real risk of failing the course, it is regarded as "soft" and has low status. From 2010 we have to cope with financial cut downs and added pressure from the study administration to "get things sorted". In this report I present my own vision of improvements, which has also been presented to the teacher group.

An interview with two former students of the course

From my project supervision and the oral course evaluation for 2009, I had a relatively clear idea of the students' opinions during and directly after the course. But how do they feel about it when a few years have passed? Has

the course left any traces in their thinking? I convinced two of the master students currently at the department to give me time for a short interview. The two students, one man, one woman, had attended the course in the autumn of 2006, almost 4 years ago.

When first approached about being interviewed the students could hardly remember the course or what it was about, during the actual interview two days later they remembered some things quite clearly, while others had faded away. The general impression they both had of the course was that it was relatively easy and provided a break in an otherwise hard schedule. Both students have clear memories of the group work, but only very vague notions of the factual contents of the book and lectures. They were genuinely interested in the subject and felt that it has a place in their education. The students couldn't say that it was the Philosophy of Science course that had specifically contributed towards the critical thinking and awareness they both say they have.

> *"My expectation of the course was that it would be quite relaxed and probably give me a bit of breathing room in between the other subjects."*

> *"Thinking back it seems like the whole course was about learning how to work in groups rather than focusing on the factual content."*

> *"I think it is a really interesting subject, the problem is that the course is so short. When there is so little time you only get to scrape the surface a bit, and you can't get into the really exciting stuff. I felt like most of the theory was things I had heard before."*

> *"Now I am quite critical in interpreting literature and I am well aware that people may have different motivations and backgrounds. I can't say it is due to this course though, I feel that is something we have been continuously taught and, of course, when writing up Bachelor's and Master's projects you get to think a lot about these things."*

The students said the group work was valuable both as training on team work and because of the discussions it generated, but they also expressed that it could be difficult to produce reports of reasonable quality when many contributions had to be compiled. It is clear that different projects had different power of connecting theory with reality, with the students remembering some other group's projects more clearly than their own because of the connections they had been able to make between theory and real life cases.

"We had endless discussions as I remember it."

"We adopted an efficient approach, divided up the work, and if there was no particular objection against a piece of work we accepted it as the consensus."

"I think I did a project that had something to do with ear infections. But what I really remember is the report and presentation of another group that worked with homeopathic treatments – that really brought the message home for me."

When asked about their abilities to work in group and to give constructive criticism the students feel that they have been properly trained throughout their education.

"I think I am good at giving constructive criticism. Also now when we are in the middle of our Master's theses me and my friends continuously read and give feedback to each others reports."

The picture that emerges from the interview is that the students had a positive experience of the course, although they grade it as relatively easy and ask for more depth in theory. They value both the theoretical contents of the course and the opportunity to train group work. It is not so remarkable that the students recall the active project work better than the passive lecturing, what is really remarkable is that the projects they remember are the ones that had the most illustrative power, even though they were made by other students.

Description of the course and its place in the Bachelor programme in Pharmacy

The two courses "Videnskabteori" (Philosophy of Science) is part of the Bachelor programme in Pharmacy after a government decision that all longer university educations should contain these subjects. The course is 3 ECTS points and is placed in the 3rd semester of the programme.

The course is setup to train the students to study complex problems with an analytical approach and to critically assess their own and other's work. The course directly adresses the overall goal for the Pharmacy programme: "Uddannelsens mål er på videnskabeligt grundlag at uddanne kan-

didater med teoretisk viden og med en etisk, fagkritisk og analytisk holdning samt eksperimentelle erfaringer, der kvalificerer til funktioner som særligt lægemiddelsagkyndige i en sundhedssektor og i et samfund i udvikling" (Studieordning for kandidatuddannelsen i farmaci; 2006).

Official course description:

T22-1 Videnskabsteori
Formål
At lære de studerende at foretage en etisk analyse/vurdering, og dermed øge den faglige bevidsthed og kritiske refleksion.

Målbeskrivelse
Ved kursets afslutning skal den studerende:

- *dels have forståelse for at videnskab ikke er værdineutral, at sandheden ikke er absolut, men kan ændre sig over tid, samt at forudopfattelser og fortolkninger ikke alene er noget, der har relevans inden for det humanistiske fagområde;*
- *dels kunne foretage en videnskabsteoretisk analyse af hændelser i og omkring den videnskabelige praksis (dvs. at formulere og identificere værdier og forudopfattelser, samt relatere disse til den analyserede hændelse.)*

Suggested changes to the course description:

One of the problems that I perceived as a new teacher, and that the students as a consequence suffered from, is the lack of clearly stated course objectives. The course intention (Formål) is directly copied from the course description of a Master's course in "Etik" (Ethics) and is therefore misleading – we do no focus on ethical aspects in this course. It should be changed to *"At lære de studerende at foretage en* ***videnskabsteoretisk*** *analyse/vurdering, og dermed øge den faglige bevidsthed og kritiske refleksion."*. The course objectives (Målbeskrivelse) are good enough in intention and ambition, but due to their vague formulation they neither describe the actual contents of the course, nor give any guidelines to teachers on how to approach the subject. In practice the course also contains some history of science and a strong focus on evidence based medicine.

It is important for students that the goals of any learning process are clearly defined, but it is even more important to the teachers! Without defined goals we don't know how and what to teach. For the course in 2010 we

will have at least two new teachers as project supervisors. They will have to learn the philosophical basis of the course as well as finding the right level of supervision for the students' projects, and clearly stated learning objectives will benefit both teachers and students. To put emphasis on what the students should learn, I suggest that we reformulate the course objectives into intended learning outcomes (ILOs) (Biggs & Tang; 2007). After participation in this course, we want the students to be able to perform certain things, and therefore it would be most suitable to define the ILOs by using verbs describing the level of performance required (Biggs & Tang; 2007). My suggestions of new, clearer course objectives/ILOs are:

After passing the course the students should be able to:

- *Describe* how science and the way we think about science have changed throughout history.
- *Explain* major ideas and development within Philosophy of Science.
- *Critically read* scientific material and *analyze* complex issues with the objectives to *identify* within which values and paradigms the authors operate.
- Clearly *present* their work at a suitable level, both written and orally.
- *Evaluate* their own and other student's work according to a set of guidelines.

All objectives will be explicitly assessed in the project work.

The student projects

The project work serves several purposes:

- By using their theoretical knowledge to analyze real world problems the students get a deeper understanding of the contents of the course as well as preparation for doing similar analyses in their professional life.
- By applying theory to cases related to their own study discipline, the students' motivation increase, and they get a better understanding of their own role in science and society.
- By having to evaluate both the work of members of the same group and evaluating another group, the students are trained to think critically and reflect over their own performance.

The teacher group is convinced that practical project work gives the students a much deeper understanding of the subject and the students generally enjoy the active participation.

Evolution of the project assignments

The first years the course was run, the projects were defined by the students – they chose a subject (with some help and suggestions), searched for literature, chose some for analysis and wrote a report focusing on Philosophy of Science aspects. This approach was chosen to strengthen motivation (the students chose their own subject) and critical thinking (the students had to select which articles to include in the analysis). The limited time the students had for the project work turned out to counteract the learning goals; most of their time was in fact spent on searching for literature, leaving very little time for analysis of the material. The learning outcomes depended highly on the quality of the material the students had found to work with, and the differences between groups were large. Each project group had to hand in a written report and prepare an oral presentation of their work, in addition they had to read another group's report and make some questions for their presentation. The exam consisted of an oral presentation of the project group, followed by questions from the opposing group. The decision to pass or fail the students was made by two attending teachers based on both the written report and the oral presentation.

For 2009, a new approach with pre-made project "portfolios" was tried. Each teacher put together a portfolio of articles and an assignment with some guiding questions. Each student group was given a project according to which teacher they has been assigned. The students got more time for analysis of the material, but since the assignments given were assembled by six persons with different ideas, the students were faced with a very wide distribution of tasks. Removing the freedom to choose project didn't seem to affect the student's enthusiasm, but there were recurring complaints about the lack of correlation between the project work, lectures and the course book. Neither teachers nor students got any clear guidelines for what the project should cover and some students expressed frustration of not knowing what was expected of them. The exam form was the same as before.

Projects 2010

To address the problem of large differences in project assignments, this year all assignments will be designed by one teacher, and there will be only four different variants. They will all have a very similar structure, with the majority of the guiding questions being the same for all projects and the assignments will relate closely to the course book. The four assignments have

been chosen especially for their power to illustrate theoretical concepts as well as being highly relevant for the Pharmacy programme. The students will be allowed to choose which project to work on, and they will have the possibility to submit their work to the project supervisor for formative evaluation and suggestions for improvements. Previously a major complaint has been the absence of guidelines as to what the projects reports should include. We will address this by compiling a list of criteria (Biggs & Tang; 2007; Harris et al.; 2007) by which the students can judge their own performance as well as the performance of other groups. This will be absolutely essential for the exams since my suggestion to the teacher group is to implement *peer evaluation*, after the final submission of reports the students will evaluate each others work to make the final decision of pass or fail.

Peer evaluation – why and how.

In previous years each project group has had the task of reading another group's report and to come with questions and (constructive) criticism during the presentation. This has been emphasized as being important and as a requirement for passing the course. From my talking to students from the 2009 and 2006 courses, I got the impression that most students only get around to reading the abstract of the other report, while one group member gets the responsibility of making some questions for the presentation. This counteracts the teachers intentions that by reflecting on other student's performance, the students will also reflect on their own performance.

Each group will judge the project report by another group against a list of criteria and based on this assessment write a recommendation of pass or fail, accompanied by a short motivation. Likewise the students will have a list of criteria by which to assess the oral presentations, and will be allowed to change their recommendation based on the presentation. This setup doesn't significantly alter the students' workload, they are already supposed to read the report of another group and come with questions and comments. The difference is that the responsibility of assessment will now be transferred to the students.

This may seem like a lot of responsibility to give the students, but with only pass or fail the task is to decide whether the work is good enough or not. I believe that with a set of clear criteria that should be relatively easy to do. It should be noted that the teachers will also read the reports and attend the oral presentations, so in cases of blatant misuse (passing an inferior piece of work, or failing a good piece of work) there are possibilities

of intervention. Formally it is still the teachers that will put their signatures on the exam lists, but it is our intention to follow the students' recommendations.

Why, then? Well it is not because of laziness; in fact the teachers will probably have to put in substantially more work to clearly define the criteria that are now only present in their minds. The benefits of peer evaluation are many (Black & Wiliam; 2001; Harris et al.; 2007). I see these points as particularly beneficial;

- By having to judge other students' work and compare it to a set of evaluation guidelines, the students will reflect also on their own work and how well it fulfills the criteria given.
- The formative evaluation (teacher feedback on project reports) will be clearly separated from the summative evaluation (pass or fail based on the list of criteria).
- The students will learn how to rate other people's performance and giving constructive criticism, an important future task for these students.

For efficient learning it is important that the students have a clear picture of what is to be learned. If the students cannot see the desired goal, they can neither estimate their present position nor find a way to achieve the goals (Black & Wiliam; 2001). Rewriting the course objectives to clearly state the intended learning outcomes is one part of our effort; the other is to provide the students with the list of assessment criteria. In principle it could be enough to let the students assess their own work, but there is a growing consensus is that evaluating others is a very efficient way to reflect on your own work;

"Commonly, peer assessment tasks are designed to encourage and enable students to critically assess their own work. In order to evaluate the work of others, students need to consider the specified assessment criteria and distinguish between different levels of achievement, or 'standards' – in this way, peer assessment develops the skills necessary for effective self-assessment." (Harris et al.; 2007)

I also believe that the added pressure of making the final assessment for another group means that the reports will be read in more detail and the students will reflect better on both their own and other's performance. This will hopefully lead to better discussions at the oral presentations.

Future restructuring of the course

High ambitions vs. economic reality

The courses "Philosophy of Science" is part of the Bachelor program in Pharmacy after a government decision that all longer educations in Denmark should include these subjects. This is an ambitious attitude, which means that students acquire a broader perspective of their own specialization and how it relates to the community as a whole. In the harsh economic climate and constant savings programs, however, it is all too easy to cut resources for subjects that are not considered defining for an educational programme.

In our current setup of the Philosophy of Science course, there are a few introductory lectures but the main part of course credits come from project work in groups. Finding and interpreting information is not trivial and each group of 6-7 students typically has 2 meetings with a project supervisor which also reads and gives feedback on the reports. The exam is an oral presentation/question session for each group with 2 teachers present. In a normal year of 220 students there are 32 projects groups running at the same time, which is of course very expensive in terms of teaching hours.

The teacher group has found that the group work is highly motivating for the students, leads to deeper learning, spurs fruitful discussions and trains critical thinking. The economic reality we have to contend with is that from the autumn 2010 there will be fewer teaching hours awarded for the course, with the possibility of even larger reductions in following years. In 2010 the teachers will just have to accept to get less teaching hours for their work, which in most cases will mean also less opportunity for the students to get feedback on their work. On a longer timescale we may have to rethink the way the course is run.

Alternatives to project work

Keeping the current project setup with less teaching hours will not be possible. Teachers cannot afford to spend more than the officially awarded time on courses. Since there are already 6-7 students in each project group, increasing the group size and thereby reducing the number of groups is not a viable alternative. The students already express frustration about the difficulties in compiling reports based on many contributions, and even the practical planning (deciding when and where to meet for group work) has turned out to be a challenge.

An alternative to project work could be to have case-based discussions in classroom sized groups (25-30). A smaller group of students (6-7) could be given a case to study at home which they then present in front of the class, and this could form the basis for one hour of discussion. With 4 cases per class, a reasonable amount of theoretical concepts could be illustrated this way, the attending teachers would have to spend less time supervising students and there would be no reports to read and give feedback on. The drawbacks are obvious; the students will not go as involved with their subjects and they will not get any feedback on their work. Without a written report it will be difficult evaluate the individual student's performance in a reliable way and the final evaluation would have to be an additional written exam, with the many hours of correcting exam papers added to the teachers' workload.

Merging the Philosophy of Science course with the compulsory Ethics course, as is already done for several science programs at University of Copenhagen, is a relatively attractive possibility. There is some overlap in the concepts of the courses and the additional time spent for organization and preparations for the course could probably be kept relatively low. That means that the number of teaching hours spent on contact with the students and giving them feedback on their work could be increased. The students' work could include a more extensive project assignment, or alternatively a shorter project combined with classroom discussion sessions. Unfortunately this is impossible to implement within the Pharmacy programmes, since the Philosophy of Science is placed within the Bachelor programme and the Ethics course is placed within the Master programme.

The cheapest alternative, just giving the course as a lecture series, is not as a sensible alternative. It is true that with more teaching (and learning!) hours spent on lecturing the course could go much deeper into theory and get to the "really exciting stuff" the interviewed students asked for. Lecturing is a very poor teaching method though (Gibbs; 1981) and furthermore, one of the interviewed students said he would not attend the lectures if the course was set up like that;

> *"I wouldn't attend the lectures in that case. I would do a cost-benefit analysis for attending and decide it would be enough to read the book on my own, and hope to pass the exam."*

The project based teaching trains so many skills that we consider important for this group of students (to work in group, to find and analyze

material, to critically assess their own and others' work) that changing it to a lecture based course would have to be the very last resort.

Conclusions

The Philosophy of Science course on the bachelor programme in Pharmacy has suffered from problems in the past, despite efforts from the involved teachers. The course objectives for this course were not clearly stated which caused confusion among both students and teachers. The organization and implementation of the student project assignments has been problematic. There was a wide spread of learning outcomes between different project groups depending on what staring material was used and what guidelines were available. The lack of correlation between the book, the lectures and the practical work lead to complaints from the students.

The teacher group will address these problems by reformulating the course objectives to better match the contents of the course, and by describing the competences we want the students to achieve. The project assignments have been completely restructured so that they will be uniform in nature and clear guidelines to what should be achieved will be provided. The available projects have been especially chosen for their power of illustrating theoretical concepts, and will to a larger extent follow the course book. By introducing peer evaluation we hope to make the students reflect more on their own learning.

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4

Continuous evaluation of a new course in molecular microbiology

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Introduction

The 7.5 ECTS course 'From gene to function in pathogenic bacteria' was given for the second time in block 3 of the academic year 2009/2010. The course had already from the start a clear idea of the teaching/learning activities (TLAs) and their alignment to the stated intended learning outcomes (ILOs) but how well has it turned out? After the first round (block 3 2008/2009) we were rather satisfied with the general outcome but there was still definitely room for improvement, especially getting the students to actively engage in discussions had proved to be difficult.

The course is given to students from several programs both at the LIFE and the SCIENCE faculty with very varied backgrounds. The diversity of the students, the second year also saw a large number of foreign students, was thus expected but the course requirements did not include any advance knowledge of microbiology and the course is on a level for any student with their basic biology courses done. Since the course relies heavily on discussion this diversity is a true asset when getting input and different angles from the students. However, we had underestimated the different expectations the students from different programs had on the course, for example had some students with a background in food science not appreciated the involvement of molecular techniques and was quite daunted by this at first.

Course description

The department of Veterinary Disease Biology section for microbiology holds much knowledge and experiments in the cross section of food microbiology, pathogenic bacteria and bacterial stress (including antibiotic resistance). The intension was to create a course that could convey different kinds of knowledge in a general course to any student that would be interested in what makes a pathogenic bacterium virulent. 'From gene to function in pathogenic bacteria' introduces several different pathogenic bacteria, the diseases they cause and how and when they cause them. The intention is that the student should be able to, not only understand what differ a pathogenic bacterium to a non-pathogenic one, but also be able to come up with strategies to explore the hypothetical unknown virulence mechanisms of a disease causing bacterium.

The course is focused heavily on discussion and they centre around the practical exercises in the lab where several techniques, used by scientist to investigate virulence genes, are introduced. Examples of these are generation of mutants, measuring of virulence gene expression and investigation of biofilm formation and emergence of antibiotic resistance. In connection to the practical exercises there are lectures as well as presentations of selected reference articles for the exercises, which are prepared by the students. Discussions, especially during introductory lectures to the exercises and article presentations, are something that is vigorously pursued in order to prepare the students for the oral examination at the end of course.

The course contains five main parts centred on the practical exercises. Each part of the course is designed by a different teacher, although the same two teachers are present in the lab for the sake of continuity, in order to get a broad range of techniques and bacteria represented. I designed the fifth and last exercise entitled 'Stress induced mutagenesis; The *Staphylococcus aureus* SOS response and antibiotic resistance'. The five parts of the course are:

1. Virulence of *Salmonella* mutant construction and biofilm formation.
2. Invasion and cell-to-cell spread of *Listeria monocytogenes* in L929 mouse fibroblast cells.
3. Global virulence regulation; Quorum sensing and the link to a small regulatory RNA in *Staphylococcus aureus.*
4. Bacterial motility and how do bacteria acquire new genetic traits? Using *Campylobacter jejuni* as the model organism.
5. Stress induced mutagenesis; The *Staphylococcus aureus* SOS response and antibiotic resistance.

Constructive alignment

The course has a list of learning outcomes (ILOs), i.e. things or skills the students should have learned during the course. Constructive alignment is the theory on how a learning environment (TLAs) is created and assessment tasks (ATs) developed that address these learning outcomes (Biggs & Tang; 2007).

ILOs

The course ILOs are divided into three parts and these are introduced and discussed at the first course introductory lecture, the ILOs are also available on absalon for the students to see prior to the course start. The ILOs describe that in the end of the course the students should be able to describe in detail different traits that make a bacterium virulent. The students should be able to exemplify how bacteria control and regulate their virulence and how they can spread, modulate and acquire (new) virulence genes. The technical skills the students practised will allow them to design experiments of their own exploring the virulence of pathogenic bacteria. They will also have the knowledge to be able to discuss and evaluate other scientists' work and put the traits of pathogenic bacteria in a broader perspective in treatment and combating bacterial diseases.

The course ILOs as copied from the course manual.

Knowledge:

- Describe molecular mechanisms of importance for virulence and persistence of pathogenic bacteria.
- Give a survey of how bacteria acquire new virulence traits including resistance to antibiotics.
- Define molecular methods introduced in the practical course.

Skills:

- Employ molecular methods introduced in the practical course.
- Design experiments to answer research hypothesis in the field of pathogenic bacteria and interpret obtained results.
- Explain generally principles in virulence gene regulation and give detailed examples here-off.
- Communicate scientific literature within the field of pathogenic bacteria to specialists and non-specialists.

Competences:

- Discuss and evaluate scientific experiments employing the molecular techniques introduced during the course.
- Discuss what can be done to combat pathogenic bacteria (in general terms).

TLAs

Each of the five parts of the course is build up chronologically as follows, although the practical work and lecture as well as the start of the different course parts might be overlapping to some extent. The oral examination is common for all the course parts at the end of the course. There was also a few lectures by invited guest lecturers giving talk on subjects that was not directly covered by the exercises but which gives further insight into bacterial pathogenicity.

1. Introduction
2. Practical work
3. Lecture
4. Article presentation/discussion
5. Summary lecture
6. (Oral examination)

Before the exercise there is an *introductory lecture* explaining what we are going do in the lab, obviously both hands on what but also why we use this to highlight an important aspect of bacterial pathogenicity. In the *practical* exercise of each part the students get to use a technique with which they can investigate the importance of a certain virulence trait, for example, in exercise 2 the students construct a mutant and then use mouse cells to investigate if this mutant are have lost the ability to infect these cells. All exercises span over a minimum of two separate days in the lab. The students are required to write reports but instead of turning it in they will bring it to the oral exam, the first ten minutes of the exam will be a presentation of the theory, background and interpretation of results of one randomly selected report.

During the *lecture* the molecular background of the genes and/or mechanisms involved are presented in more detail and the students then gets time to discuss their results from the ongoing practical exercises as well as speculating on what we might expect from the final results. Each part of the course also has one or two *articles*, to be *presented* by the groups, detailing work closely related to their practical exercise. The articles and dates of

presentation are distributed in the beginning of the course. The idea here is that by 'teaching' themselves they get another way of learning, and most importantly, formulating the information with their own words.

Since each part of the course span over a long time it is *summarized* in a session where the students gets to recap and reflect on what that part of the course focused on. This session gives the students time to discuss their final results and put them in a greater perspective of bacterial pathogenicity. We do not want this session to be us teachers telling what we did so use only a few slides with pictures, tables and graphs from the students' own results to start the discussions. These summarization sessions are also used as an opportunity for the students to ask question about their report and this part in general in preparation for the exam. Since discussion, explanation and communication is central to this course we believed that assessing the students by *oral examination* was the best way to go. The examination is 30 minutes long with the first ten minutes being the report presentation. They have been instructed to present the theory behind the report and results and conclusion with their own words. This evaluates the 'knowledge' part of the ILOs and after this we assess the 'skill' and 'competence' parts with questions where they, for example, need to suggest ways to combat or examine a pathogen.

Evaluation

The evaluations are done no only to see what went well and what did not but also to see if the important alignment between the TLAs, ILOs and the AT is working. I discuss what our internal evaluation came up with after each of the two rounds the course has been given and summarize the major points that we identified and how we addressed them.

First round

When the course finished after the first time it was given, we (the teachers) sat down and discussed how the course had turned out, did the different course elements work as intended and had the students reach the intended learning outcome? We discovered some minor errors in the course material, which was corrected as we found them, but overall we were satisfied with to outlay of the course. One thing that we felt needed improvement was the discussions. Speaking up in a class and getting a discussion going is not

always easy but there was an open easy atmosphere where everyone voiced their opinion and asked questions. However, many had not grasped that the discussions are excellent training for the oral exam and we felt that we had failed to convey the learning outcomes of discussing and evaluating. The skills we are assessing in the oral exam include their ability to discuss and evaluate scientific experiments and the general topic of pathogenic bacteria. For the next time we considered how to improve the discussion and make them more central, we also have to make the course ILOs more visible. The first thing was to make sure that the students had seen our TLAs and, to make them understand why we use the ones we use, our ILOs. This will now be given more space in the course introduction. The second thing we changed was to highlight in what way the examination is conducted so the students understand the need for practising formulating their thoughts out loud. Another change was to increase the way the summary lecture was conducted as well as the time allocated for it. These summary lectures was to be more of a summary discussion that lecture with the teacher responsible for that part of the course giving only a quick recap and then driving the discussion with questions, such as simply 'what did we do here and why… what does that tell us', and short small group discussion.

There was some confusion of why we did not collect and correct the reports prior to the oral exam. Our intention here was that we should not correct the written form of the report but rather how they discuss and explain an exercise orally. If they have questions about calculations or the theory and details this could be addressed during the lectures and summary sessions. The written report is then only a support when presenting the (random) report during the exam. Considering that collecting, reading and correcting reports during a course is more common we felt that we had to be clearer of how the reports are intended to be used in this course.

The course was designed for student from different educational programs but we still thought that certain parts might be more of a challenge for some students. For example the students from the food science program have had less molecular biology and they are less experienced in the lab, on the other hand they have more experience with pathogens and food spoilers something that was new to other students. These concerns, however, proved to be unfounded and we had students from every represented program receiving good grades. Some students were struggling more than others with the practical parts but not to an extent that makes us questioning the difficulty of the course.

- Problem with using discussions as a TLA.
  We will better explain our usage of discussions to reach our ILOs.
  We will highlight what we test in the oral exam.
  We will expand and modify the summary sessions.
- Misunderstanding the use of exercise reports.
  We will better explain how the reports are intended to be used and how they can get feed back on questions concerning them.

Second round

Having implemented the changes from the first year evaluation we managed to get the discussions more intense and 'emptying', even if that the student composition being vastly different from last year. The first year students the first year had all been Danish students from different programs and faculties, the second year over half the students was foreign exchange students. Some of the second year students came from a cultures were disapproving or arguing against the teachers is not done (to various extent), most of the time this was not a problem when discussing and any possible confusions could be avoided by asking a question in another way. However, this culture of not saying no to a teacher resulted in some mishaps in the laboratory. In one example I showed two students how a piece of equipment worked and asked them if they understood for which they answered 'yes'. Two yes and two emergency shut down of the machine later I realized I had to approach this somewhat differently. The incidents I had in the lab with some of the foreign students were more an experience and learning situation for me personally as a teacher rather than a needed improvement of the course. I have a lot of experience teaching in lab environments and foreign students, but this was the first time there was foreign students from a non-western country.

One thing we noticed did not work as smoothly this year compared to last year was the students own article presentation/discussion session. We had been very satisfied with the outcome of this the first year, with clear presentations and good discussion in which we barely had to intervene in order to keep the discussion going. Maybe those students had more experience with presenting in class. Many presentations were simply over loaded with information so both the presenters and the listeners were completely overwhelmed by the end and there was little energy left for the discussions, which this group were otherwise so adept at. Another problem with to much information in the presentation also showed in that the other students did

not really know what to ask question about. After this turn of events with the student presentations we have decided to put together a set of tips and instructions on how to make a good presentation, of an article, and get a good discussion going. We will also allocate time for each group to sit down with the teacher, who designed that part of the course, before the presentation. This far the students had been told to come and ask if they ran into trouble with the article.

Quality of article presentations.

- Prepare a set of tips and instructions on article presentation.
- Set time aside for a group/teacher meeting.

Conclusions

The course evaluations from the students, which I have not commented in this project, were generally very good for both years; especially good to see is that they thought our TLAs supported our ILOs. There had been a clear idea from the beginning in this course on what we wanted the students to learn and how to get them to learn it, for most part those ideas worked well and there has not been so many major changes that has been needed to be done. Mostly our changes have been centred on improving information of course activity and adding some written material to the students. It was interesting to see how something that worked well one year did not the next, showing the importance of continuous evaluation of a course, especially a new one. All in all, after having run the course twice with a wide variety of students (both faculty and country of origin wise) we think our constructive alignment has shown to be robust. The variety of students that might sign up for this course put a high demand on our course material and our usage of TLAs but after these first two rounds we feel that it holds up to the challenge. It has been interesting to follow how the students, as the course progress, could come up during a waiting period of an exercise to talk about something, which occasionally precipitated an improvised discussion and/or mini lecture in the lab, and I feel excited to teach again on this course next year.

5

Constructive alignment: Udvalgte temaer i Sundhedsantropologien, Seminarierækken

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Indledning

Et af de centrale begreber i det universitetspædagogiske og -didaktiske forløb, som jeg har gennemført i forbindelse med adjunktpædagogikum, har været begrebet 'constructive alignment' (Biggs & Tang; 2007, p.52). Constructive alignment er en måde at skabe større sammenhæng i kurser og uddannelser på universitetet og dermed øge de studerendes læring. For at et kursus kan siges at være baseret på principperne om constructive alignment, skal det dels bygge på, hvad de studerende allerede ved (constructive) og dels skal der være en sammenhæng mellem kursets eller uddannelsens enkelte elementer (alignment), dvs. mellem kursets eller uddannelsens læringsmål (ILO – intended learning outcomes), de aktiviteter man som underviser planlægger for de studerende og den afsluttende eksamen (Ibid.). Ifølge Biggs & Tang (2007) vil kurser og uddannelser, der baserer sig på principperne om constructive alignment, fremme de studerendes læring. Denne opgave er en analyse af et kursus ud fra principperne bag constructive alignment, samt en præsentation af forslag til elementer, der med fordel kan tilføres kurset for at gøre det mere constructive aligned.

Jeg vil i denne opgave arbejde med det kursus, som jeg underviste efteråret 2009: Udvalgte temaer i Sundhedsantropologien, Seminarierækken. Kurset ligger på 3. modul på Masteruddannelsen i Sundhedsantropologi. Kurset præsenteres i denne teksts følgende afsnit. I forhold til principperne for constructive alignment har dette kursus to problemområder. Det ene problemområde er, at de ord, der anvendes i kursusmålene omkring kernekompetencen – at kunne lave en antropologiske analyse – er relativt va-

ge eller uspecifikke. Det andet problemområde er, at der i undervisningen mangler et fokus på skriftlighed, som er et centralt element i den eksamen, som kurset afsluttes med. Den nærmere analyse af kurset vil blive præsenteret nedenfor, efter præsentationen af kurset.

På baggrund af denne analyse vil jeg i dette afsluttende KNUD-projekt arbejde med en videreudvikling af kurset, så det i højere grad vil kunne siges at være constructive aligned. Kurset vil først blive afholdt igen i efteråret 2011, så der vil ikke være mulighed i forbindelse med denne opgave at evaluere, hvorvidt kurset efter en sådan videreudvikling bliver bedre. Formålet for projektet er at producere en 'undervisningsvejledning', der kan anvendes ved næste kursusgennemførsel. Denne præsenteres i opgavens afsluttende afsnit.

Beskrivelse af det eksisterende kursus

Master i Sundhedsantropologi er en to-årig deltidsuddannelse, der udbydes på Institut for Antropologi, Københavns Universitet. Målgruppen for uddannelsen er primært sundhedspersonale med en mellemlang uddannelse (sygeplejersker, fysio- og ergoterapeuter, jordemødre m.fl.). De studerende tager som regel uddannelsen ved siden af deres almindelige arbejde. Formålet med uddannelsen er at "... give især personale fra sundhedssektoren en kompetencegivende videregående uddannelse inde for et veletableret tværfagligt forskningsfelt, der belyser de sociale og kulturelle dimensioner af sygdom og sundhed" (Institut for antropologi 2009: 1).

Uddannelsen består af fire moduler (svarende til semestre). Første modul er en generel introduktion til antropologi. Andet modul er en introduktion til sundhedsantropologiens grundbegreber. På tredje modul beskæftiger man sig mere i dybden med nogle udvalgte temaer inden for sundhedsantropologien. Fjerde modul består af et kort kursus om etnografiske dataindsamlingsmetoder og derefter den afsluttende opgave, der strækker sig over det meste af dette sidste modul. Denne opgave er et lille projekt (et minispeciale), hvor de studerende selv skal finde frem til en relevant antropologisk problemstilling med relevans for deres eget arbejdsfelt, designe dataindsamling, gennemfører dataindsamlingen og skrive en afsluttende opgaver, hvor de analyserer det indsamlede materiale.

På uddannelsens tre først moduler består undervisningen dels af en forelæsningsrække, hvor de studerende overværer 10 forelæsninger (en om ugen), og dels en seminarierække, hvor de studerende har fire weekend-

seminarer (fredag og lørdag med fire ugers mellemrum). Seminarierne består af gæsteforelæsninger, undervisning ved lærer, gruppearbejder, øvelser, film m.m. Det er i høj grad på seminarerne, at der er en dialog mellem underviser og de studerende, og hvor man for alvor har mulighed for at eksperimentere med formen. Forelæsningsrækken er mere bundet i sin form, fordi der også deltager studerende fra åben uddannelse på forelæsningerne, hvilket betyder, at man har mindre mulighed for at tilpasse undervisningen netop de masterstuderendes behov og niveau. De tre moduler afsluttes alle tre med én skriftlig hjemmeopgave, der dække både seminarie- og forelæsningsrækken.

Denne opgave beskæftiger sig med uddannelsens tredje modul og med seminarierækken. Målene for kurset er ifølge studieordningen (Institut for Antropologi; 2009, 10), at den studerende skal kunne:

- Selvstændigt opsøge, anvende og vurdere antropologisk litteratur
- Selvstændigt koble teori med empiri fra eget felt eller litteraturen
- Begrunde relevansen af den analytiske tilgang i forhold til problemstilling
- Formidle et relevant antropologisk budskab i forhold til en udvalgt sundhedsfaglig målgruppe

Kigger man på disse læringsmål er det tankevækkende, at de ikke forholder sig til det specifikke indholdsmæssige: De siger ikke noget om, hvad det er for noget antropologisk litteratur, man skal kunne opsøge, anvende og vurdere, eller hvilken teori, der selvstændigt skal kobles. Det sundhedsantropologiske er ikke nævnt med et ord. Læringsmålene dækker derimod i vid udstrækning delementerne i, hvad det vil sige at lave en antropologisk analyse: Identificere litteratur og bruge denne litteratur til at analysere empirisk materiale.

Denne vægtning af det analytiske fremfor et mere snævert emnemæssigt fokus styrkes også af tredje moduls placering i forhold til den samlede uddannelse. På fjerde modul fokuseres der undervisningsmæssigt primært på metode til dataindsamling og ellers er vægten på de studerendes egne projekter. I disse projekter skal de vise, at de kan lave en antropologisk analyse af eget indsamlet materiale. Så tredje modul er i den samlede uddannelses perspektiv sidste mulighed for at modtage undervisning i, hvordan man laver en antropologisk analyse.

Den måde, som undervisningen normalt foregår på på faget antropologi, er, at man til hver undervisningsgang har en række tekster, der på en

eller anden måde har relation til hinanden (f.eks. dækker samme emne, bruger samme tilgang til forskellige emner, eller lignende), og som man læser inden undervisningen og bruger på forskellig vis i undervisningen. F.eks. til at finde ud af, hvad antropologien mener om et givent emne, hvordan et givent emne typisk har været studeret, hvad man kan bruge en række forskellige metoder til, eller lignende – alt efter kursets emne. Underviserens rolle er at facilitere de studerendes arbejde med teksterne. Dette kan gøres på forskellig vis: Man kan give en autoritativ udlægning af teksten (som de studerende kan bruge som hjælp til, hvordan man kan læse tekster som denne, eller som de kan være enige eller uenige i), man kan give en ramme at sætte teksten ind i (faghistorisk, emnemæssigt eller anvendelsesmæssigt), man kan have formuleret en række spørgsmål med relation til teksterne, som de studerende skal diskutere – som oftest i grupper, de skal prøve at relatere teksterne til deres egne projekter osv. Tit vil man gennem et undervisningsforløb veksle mellem disse forskellige aktiviteter. Det er karakteristisk for alle disse aktiviteter, at de er mundtlige.

I forhold til det kursusforløb, som denne opgave behandler, så var teksterne koncentreret rundt om fire – primært empiriske – temaer: Risiko, kontrol og forebyggelse; Køn; Normalitet og afvigelse; og Alder og generation. Ovenstående eksempler på undervisningsaktiviteter blev anvendt.

Eksamen består af et ti-siders essay, hvor den studerende selv har skullet vælge emne og lave en problemformulering – inden for sundhedsantropologiens emneområde. De har en times vejledning til dette. Essayet kan skrives løbende gennem hele semestret og bedømmes af vejleder og ekstern censor. Denne eksamen er en slags øvelse til deres efterfølgende modul (semester), hvor de som nævnt skal skrive deres afsluttende opgave.

Analyse af det eksisterende kursus på baggrund af teorierne om 'constructive alignment'

Et af kravene fra principperne om constructive alignment er, at der skal være nogle klare og godt formulerede læringsmål for kurset, som man kan bruge til arbejdet med at planlægge undervisningsaktiviteterne. Som beskrevet ovenfor er det overordnede mål med kurset, som dog ikke klart ekspliciteres, at lære de studerende at lave en antropologisk analyse, og at læringsmålene i vid udstrækning kan siges at dække denne proces. På den anden side vil et mere kritisk blik på læringsmålene vise, at de centrale ord 'anvende', 'vurdere' og 'koble' er relativt vage og uspecifikke. Hvad vil det

f.eks. sige at koble teori med empiri? Er det at vise mekanisk, at forskellige teoretiske begreber kan genfindes i det empiriske materiale, eller skal der noget mere til, og i så fald hvad der dette mere? Kigger man på kravet om, at der skal være en sammenhæng mellem læringsmål, over undervisningsaktiviteter, til eksamen bliver det tydeligt, at der i undervisningen mangler et fokus på det skriftligt, som er det, der bedømmes til eksamen. I målene står der kun 'formidle' uden at det ekspliciteres, hvilken slags formidling der er tale om. I undervisningen ligger fokus klart på det mundtlige, mens eksamen som nævnt består i en skriftlig opgave; et essay. For at dette er et problem kræves det, at der er forskel på mundtlig og skriftlig formidling. Det mener jeg, at der er, på i hvert fald to områder. For det første, så skal man i den skriftlige formidling kunne holde en logisk struktur gennem hele opgaven. Dette krav er ikke så gældende mundtligt, hvor argumentationen i højere grad kan være fragmenteret uden at det på samme måde er meningsforstyrrende. For det andet, så har argumenter og udsagn ofte en mere bindende karakter på skrift end i tale og skal derfor formuleres mere omhyggeligt og ofte også med større forsigtighed eller med flere forbehold. Det kan derfor blive et problem for de studerende, at de kun i meget begrænset omfang i undervisningen trænes i den skriftlige disciplin, som de bedømmes på til eksamen. De kriterier, der bliver brugt til bedømmelse af essayene i eksamenssituationen (jeg har været med til at bedømme disse 3. moduls essays på 5 årgange), er i vid udstrækning de faglige mål for kurset, så ved første øjekast er der her en fin sammenhæng mellem kurset og eksamen. Det er dog også tydeligt, at der i vurderingen sniger sig nogle lidt mere implicitte kriterier ind. Som regel formuleret som, om de studerende lever op til de faglige mål 'på en god måde' eller 'en elegant måde'. De studerendes eksamensessay lever som hovedregel op til de faglige mål, men alligevel er der ikke tvivl om, at der er kvalitetsforskel på opgaverne: Nogen gør det bedre, mere elegant, mere overbevisende end andre [1]. Denne kvalitative dimension er kun i begrænset omfang synlige i de faglige mål. Et bud – og mit bud i denne opgave – er, at denne manglende synlighed hænger sammen med den vage definition af, hvad en antropologisk analyse er (det første problemområde) og at en afhjælpning af dette problem, også vil tydeliggøre for de studerende, hvordan en antropologisk analyse udføres på en kvalificeret eller god måde. Inden jeg når frem til den afsluttende præ-

[1] Dette er dog ikke kun noget, der gør sig gældende for masterstuderende; også i forhold til studerende, som har antropologi som hovedfag finder man tilsvarende kvalitetsforskelle

sentation af, hvordan kurset – Udvalgte temaer i Sundhedsantropologien, Seminarierækken – i højere grad kan blive constructive aligned, vil jeg kort diskutere de to områder; antropologisk analyse og skriftlighed. Der er tale om en meget kursorisk diskussion af to for faget meget centrale områder.

Antropologisk analyse

Svaret på spørgsmålet om, hvad en antropologisk analyse er, bliver sjældent ekspliciteret i faget. Det har i mange år haft status af et esoterisk fænomen; kunne man selv knække koden var man værdig til at blive antropolog. I en grundbog om faget skriver forfatteren: "…but there is something shared by ethnographers, an implicit understanding of how data are analysed" (O'Reilly; 2005, p. 178). Det er nok også kendetegnende, at formålet med den antropologiske analyse angives meget prosaisk som værende: "…making some sense of it all [dvs. empirisk materiale]" (Ibid: 184). Det er først inden for de sidste par år, at der er indført et fag på kandidatuddannelsen i antropologi, der specifikt sigter mod at lære de studerende at lave en antropologisk analyse af deres eget materiale. I tekster om antropologisk analyse beskrives det som et centralt kendetegn, at den analytiske proces ikke kan adskilles fra andre processer i det videnskabelige arbejde. Analysen er i gang, når forskningsspørgsmål defineres, når data indsamles, når de bearbejdes og når man skal præsentere sine resultater på skrift (f.eks. O'Reilly; 2005; Hammersley & Atkinson; 1983, p. 74). O'Reilly kalder denne proces for iterative-induktiv analyse (O'Reilly; 2005, p. 178). Hun beskriver analysens elementer eller progression med følgende stadier: Beskrive, sortere, udvikle begreber og tænke over teori (O'Reilly; 2005, p. 206). Hammersley & Atkinson beskriver i en anden grundbog den analytiske proces i meget parallelle termer: Omhyggelig læsning af materialet, finde begreber, der udspringer af teksten (enten empiriske eller teoretiske), finde sammenhænge mellem disse begreber (analytisk begrebsapparat). Hvis begreberne indgår i et større teori-kompleks, kan dette kompleks lede til andre begreber eller sammenhænge (Hammersley & Atkinson; 1983, pp. 180-181). I forhold til kurset Udvalgte temaer i Sundhedsantropologien vil jeg foreslå, at der i de faglige mål sker en eksplicitering af analysens elementer – frem for de vagere begreber omkring 'anvende' og 'koble'. Dette vil tydeliggøre for de studerende, hvad en antropologisk analyse handler om, samt tydeliggøre bedømmelseskriterierne, der nu ind i mellem kan forekomme vage i forhold til, at det er gjort på en god måde. Følgende punkter

er forslag til, hvad de studerende skal lære i forhold til en analyse. Disse kan identificeres i tekster, som de studerende læser som en del af pensum eller de studerende kan arbejde med dem i mindre skriftlige arbejder undervejs i modulet:

- At de analytiske begrebers anvendelighed i forhold til empiriske materiale bliver diskuteret
- At de studerende styrker deres opmærksomme for, at en teoretisk læsning af det empiriske materiale netop er én læsning – formentlig ud af flere
- At der skal argumenteres for en given læsning
- De analytiske begrebers relation til det empiriske materiale (vokser ud fra, lægges ned over...)
- At de analytiske begreber skal bruges til at fremdrage elementer og sammenhænge i empiriske materiale af relevans for problemstillingen
- At forskellige analytiske begreber bliver forholdt til hinanden, således at der skabes mulighed for en progression i analysen

Jeg er opmærksom på, at det ikke er alle forhold ved en universitetsopgave, der kan stilles op på en formel eller en tjekliste. Det er formentlig heller ikke alt, der kan – eller skal – ekspliciteres. Nogle ting skal læres ved, at man gør det i praksis og får respons på dette. Men jeg mener dog, at man godt kan gå et stykke længere i forhold til eksplicitering af en analyses elementer i forhold til de eksisterende læringsmål.

Skriftlighed

Derudover vil jeg foreslå en opprioritering af det skriftlige arbejde på modulet, således at de studerende i højere grad bliver introduceret til skriftlighed. Generelt giver de studerende udtryk for, at læsning af pensum tager al deres forberedelsestid, og introduktion af yderligere skriftligt arbejde oven i dette pensum vil være vanskeligt. Men der mulighed for at udnytte seminarieforme, hvor der vil være tid til, og behov for, at gøre noget andet end bare tavleundervisning, f.eks. at bede de studerende skrive små øvelser og kommenterer på hinandens øvelser (peer-vurdering). Det er generelt et krav for masterstuderende, at deres uddannelse skal have relevans for deres arbejdsmæssige praksis (Aarkrog; 2008). Dette gælder også for de masterstuderende i sundhedsantropologi. I forhold til principperne om constructive alignment er der ligeledes et krav om, at undervisningen skal bygge på

viden, som de studerende allerede har. En måde at kombinere disse krav på er at bruge de studerendes arbejdsmæssige praksis som empirisk materiale, som de kan øve sig i at beskrive, og som de kan øve sig i analysens forskellige elementer på, og som samtidig vil forankre deres færdigheder i deres arbejdsmæssige virkelighed. Konkret ville mit forslag være, at de studerende i forbindelse med hvert seminar brugte et par timer på skriftligt arbejde og respons. De konkrete opgaver kunne være:

- Skriftlig præsentation af eget empirisk materiale (f.eks. en typisk arbejdsdag (grand tour))
- Skriftlig præsentation af eget empirisk materiale med en specifik begrebsmæssig vægtning (f.eks. magtrelationer, udveksling, ritualiseret praksis)
- Kommenterer på andres skriftlige arbejde
- Bruge egne empiriske fremstillinger som empirisk materiale til forskellige analytiske greb (inspireret af foregående afsnit)
  - Diskutere udvalgte analytiske begrebers anvendelighed (eller mangel på samme) på materialet
  - Diskutere relationen mellem det empiriske materiale og de analytiske begreber
  - Analysere materialet med forskellige analytiske begreber og diskutere forskellene i resultaterne
  - At binde disse forskellige analytiske begreber sammen og dermed skabe en progression i analysen

Sammentænkning/inkorporation

I en ny version af kurset vil der være tre områder, der skal dækkes af litteratur og læringsaktiviteter: Der vil være en temamæssig dækning, hvor de studerende skal læse noget om udvalgte temaer i sundhedsantropologien. Som nævnt var sidste års temaer: Risiko, kontrol og forebyggelse; Køn; Normalitet og afvigelse; og Alder og generation. Det specifikke valg af temaer og litteratur vil til dels komme an på interesser og kompetencer hos den konkrete underviser, som forestår kurset. Derudover vil der være en analysemæssig vægtning, hvor de studerende skal arbejde med forskellige delelementer i den analytiske proces på baggrund at pensums tekster. Dette stiller relativt store krav til udarbejdelse af pensum, hvor der skal være et relativt indgående kendskab til pensum på forhånd, da pensum ikke kun skal

dække de temamæssige krav, men også skal kunne bruges som eksempler på forskellige analytiske tilgange. Endelig vil der være en større vægtning af det skriftlige, hvor der arbejdes dels med empirifremstilling og dels med forskellige elementer af en analyse. Nedenstående er en konkret liste med læringsaktiviteter:

1. seminar: Særligt fokus på at identificere de analytiske begreber i teksterne og hvordan disse begreber forholder sig til hinanden. Skrive tre sider empirisk materiale fra egen felt, der introducerer felten. Læse og kommenterer en medstuderendes beskrivelse. Skrive en side empirisk materiale fra egen felt, hvor man vægter et af de analytiske begreber, som er identificeret i teksterne.

2. seminar: Særligt fokus på at identificere de analytiske begreber i teksterne og hvordan disse begreber forholder sig til hinanden (gentagelse). Lave en skriftlig analyse af det empiriske materiale fra sidst (de tre sider) med brug af et af de analytiske begreber. Læse og kommentere en medstuderendes analyse.

3. seminar: Særligt fokus på, hvordan forfatterne begrunder valg af analytisk tilgang og hvordan denne tilgang afspejler sig i teksterne. Skriftlig argumenterer for, hvilke analytiske begreber, der ville være mest relevant i analysen af en konkret empirisk case fra egen felt. Læse og kommentere en medstuderendes argumentation.

4. seminar: Særligt fokus på, hvordan relationen er mellem de analytiske begreber og det empiriske materiale. Skriftligt præsenterer en tentativ tresiders analyse. Respons fra underviser og medstuderende.

I forhold til læringsmålene vil jeg foreslå følgende ændringer:

- Selvstændigt opsøge, anvende og vurdere antropologisk litteratur (oprindeligt mål)
- Have kendskab til og kunne anvende forskellige analytiske metoder på empiri fra eget felt eller litteraturen til at generere en ny forståelse af det empiriske materiale (nyt mål)
- Præsentere og diskutere forskellige analytiske begreber i forhold til hinanden (nyt mål)
- Demonstrere en opmærksomhed over for den valgte analytiske tilgangs muligheder og begrænsninger (nyt mål)
- Demonstrere en opmærksomhed omkring relationen mellem empiri og teori (nyt mål)
- Begrunde relevansen af den analytiske tilgang i forhold til problemstilling (oprindeligt mål)

- Skriftligt kunne præsentere en relevant antropologisk analyse i forhold til en udvalgt sundhedsfaglig målgruppe (nyt mål)

En ændring af læringsmålene vil kræve en ændring af studieordningen. Ovenstående forslag til ændringer af kursets indhold kan dog sagtens gennemføres inden for rammerne af den eksisterende studieordning. En ændring af studieordningen vil dog betyde en skærpelse af opmærksomheden hos den enkelte underviser.

6

Omstrukturering af Statistik for Psykologer

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Indledning

Projektets formål er at evaluere forløbet af det obligatoriske statistikkursus for psykologistuderende. Kurset er blevet afholdt uændret i årtier, men har i år 2010 på mit initiativ gennemgået væsentlige indholdsmæssige ændringer. Derudover var der nogle pædagogiske overvejelser, specielt med hensyn til evaluering af de studerende samt formen på øvelsesholdene. De indholdsmæssige ændringer var en succes. Men der er stadig mulighed for at forbedre den konkrete afholdelse af kurset og specielt koblingen til de øvrige fag på uddannelsen. Dette projekt forsøger at overveje, hvordan kurset kan gøres bedre næste år i særdeleshed med hensyn til de studerendes motivation og engagement.

Baggrund

Baggrunden for projektet er, at jeg som kursusansvarlig netop har afsluttet kurset Elementær Statistik på Institut for Psykologi (ES-psy). Det er et obligatorisk 12 ugers kursus for førsteårsstuderende på psykologi i andet semester. Kurset er normeret til 5 ECTS point og havde i år 210 tilmeldte studerende. Kurset bestås ved 75 % fremmøde til holdundervisningen samt godkendelse af tre afleveringsopgaver. Ud over den ugentlige holdundervisning (2x45 minutter) er der en forelæsningsrække på 12 gange à 2x45 minutter. Forelæsningerne er ikke obligatoriske. Jeg har haft forelæsningsrækken og to øvelseshold, de øvrige øvelseshold er blevet under-

vist af ph.d.-studerende i psykologi. På bacheloruddannelsen i psykologi har de studerende to større redskabsfag og to mindre. Alle fire fag ligger på første år. I efterårssemesteret er der Psykologiens Undersøgelsesmetoder, Videnskabsteori og Psykologiens Historie. I forårssemesteret er det eneste redskabsfag Elementær Statistik, det er kun faget statistik, der beskæftiger sig med kvantitative metoder. Især to forhold har haft betydning for planlægning af kurset i 2010. For det første har hovedparten af de studerende en meget lille forståelse for, hvorfor de skal beskæftige sig med statistik, når de nu er indskrevet på psykologi. For det andet formidler de ældre årgange en negativ og kortsigtet tilgang til kurset, som handler om, hvordan man nemmest består kurset uden køb af bog, deltage i forelæsninger og tilegne sig pensum. Problemet er altså ikke kun, at pensum umiddelbart ligger langt fra de studerende primære interesse: psykologi. De nye studerende påvirkes også til at bestå kurset med mindst mulig indsats.

Målsætninger for undervisningen

Formålet med undervisningen var at lære de studerende statistik. Motivationen til dette skulle komme ved at vise at statistik er et brugbart og værdifuldt redskab for psykologistuderende (og psykologer). Dette styrede valget af pensum og måden, der blev arbejdet med pensum i form af eksempler, opgaver og afleveringsopgaver.

De konkrete målsætninger var at indføre de studerende i de fundamentale og centrale begreber i statistik. Herunder var formålet at gøre de studerende bekendte med de basale værktøjer indenfor deskriptiv statistik samt de mest almindelige analysemetoder. Fokus var i år 2010 i højere grad lagt på forståelse, fortolkning og diskussion af resultaterne af en statistisk analyse frem for at de studerende var i stand til at gennemføre en statistisk analyse ved en computer. En målsætning var også, at de studerende skulle være i stand til at oversætte statistiske konklusioner til lægmandssprog og dermed kunne formidle resultater af statistiske analyser samt være kritiske over for resultaterne.

Planlægning af Elementær Statistisk 2010

I planlægningen af ES-psy 2010 benyttede jeg høj grad erfaringerne fra forprojektet "De studerendes motivation i redskabsfag". Her blev det i KNUD-

regi undersøgt ved fokusgruppeinterview, hvad der kunne fremme de studerendes motivation og engagement i redskabsfag som statistik. En af de bagvedliggende antagelser i forprojektet (generelt) er, at læring i høj grad afhænger af den studerende motivation. Erfaringerne fra forprojektet var ikke opmuntrende, og der var bestemt punkter, hvor ES-psy kunne forbedres, hvilket illustreres glimrende ved citater fra de studerende, der deltog i interviewet. Den overordnede fornemmelse var således, at de studerende havde oplevet ES-psy som en "motorisk øvelse i SPSS". Blandt de yngre studerende var der også en generel oplevelse af "at de ikke havde lært noget som helst i kurset" eller "kun havde lært noget som de hurtigt selv ville kunne have tilegnet sig, hvis de fik brug for det". Samtidig var der blandt de ældre studerende en udpræget frustration over, at de ikke havde lært noget på kurset. På overbygningen kunne de studerende i høj grad mærke, hvor meget de havde brug for faget som redskab. De var undrende over, hvorfor de ikke havde lært dette eller hint element. Flere kommenterede også, at hvis man havde illustreret brugen af faget inden for eksempelvis disciplin A eller B, så havde de kunne se, hvorfor de skulle lære det. De studerende mente ikke, at der var deres egen skyld/fortjeneste, at de ikke havde lært noget brugbart. Hovedparten mente ikke, at var blevet undervist i noget relevant. Overraskende mange studerende var gået meget metodisk til værks i planlægningen af, hvordan de skulle tage kurset. Men vel og mærke med henblik på at bestå lettest muligt. De havde inddelt sig i grupper og planlagt hvem der skulle dukke op til hvilke øvelser. Herefter delte de afleveringsopgaverne imellem sig, arvede opgavebesvarelser fra ældre studerende osv. På den måde kunne kurset bestås uden at lære statistik i nogen nævneværdig grad. For at imødekomme nogle af kritikpunkterne og opfylde målsætningerne for ES-psy, specielt med at vise statistik som et værdifuldt redskab for psykologistuderende, startede jeg med at udskifte dele af pensum. For at motivere de studerende tog jeg udgangspunkt i noget de studerende ville finde relevant. De forskellige begreber er således konsekvent blevet introduceret ved at tage udgangspunkt i en psykologisk problemstilling. Ligeledes blev indholdet af holdtimerne og deres afleveringsopgaver ændret. Tidligere har holdtimerne været præget af standardopgaver fra lærebøger, der skulle løses ved hjælp af computere. I år har jeg lagt vægt på forståelse og diskussion af resultater og metoder. Samtlige opgaver har derfor taget udgangspunkt i noget psykologisk relevant datamateriale jeg har regnet på for læger eller psykologer. Alternativt var materialet fundet i nyere artikler fra anerkendte tidsskrifter. Via det øgede kendskab til data, er det nemmere at stille meningsfyldte opgaver, der kan tage højde for den givne

problemstilling og diskutere den. Samtidigt gør det statistik mere virkelighedsnært for de studerende: Der er psykologer, der har brugt faget til at diskutere interessante problemstillinger og til at drage relevante konklusioner. For at gøre afleveringsopgaverne meningsfyldte for de studerende var disse baseret på en god nyere artikel i et anerkendt tidsskrift. Opgaverne var så at læse og forstå disse artikler, formidle resultaterne, samt i enkelte delopgaver at regne videre på data. Formålet med disse opgaver var at vise de studerende, dels hvor meget de lærte på kurset, idet de ikke ville have kunne læse artiklerne før kurset. Dels at vise de studerende, at statistik er et vigtigt redskab, hvis de vil kunne læse den slags artikler. For at opfylde målsætningen med at lægge vægt på forståelse og diskussion ændrede jeg det praktiske forløb af holdtimerne. Tidligere har holdtimerne været computerøvelser, jeg valgte kun at lade to af de 12 øvelsesgange være computerøvelser. Hvis man skal sidde foran en computer, er der for mange ting at forholde sig til samtidigt: statistik, nyt computerprogram og uoverskuelige data. Hvis alle tre dele er nye, er der en risiko for, at den første og vigtigste del ikke bliver prioriteret. Det er nemlig i høj grad muligt at få eksempelvis SPSS til at lave avancerede analyser uden at forstå, hvad der foregår. Da målsætningen i år i højere grad end tidligere fokuserede på fortolkning og forståelse blev der lagt mindre vægt på at lære de studerende at gennemføre en analyse selv. De to computergange blev dels indført, fordi de studerende i høj grad efterspurgte dem. Dels fordi det er et vigtigt værktøj i statistik og i et længere statistikkursus må man stifte bekendtskab med noget standard programmel. Computerøvelser lå i slutningen af kurset, fordi jeg ikke var klar over, hvordan kurset ville komme til at forløbe og i hvor høj grad, de studerende ville efterspørge netop dette element.

Evaluering af Elementær Statistik 2010

Kurset blev evalueret to gange i løbet af semesteret. Den afsluttende evaluering er endnu ikke tilgængelig. Den første evaluering var efter kun fire ugers undervisning. Undersøgelsens formål var at undersøge sammenhængen mellem gruppe-dynamik og self-efficacy. Specifikt undersøgtes sammenhængen mellem en værdifuld studiegruppe, identifikation med det at være en psykologistuderende samt troen på, at man kan løse en statistik opgave og bestå kurset. Fra dette projekt er det specielt besvarelserne i kategorierne Goals, Relevance og Preperation, der er af interesse for denne opgave. Den første kategori måler i hvor høj grad den studerende er inter-

esseret i at blive bedre til statistik. Dette måles som gennemsnittet af tre underspørgsmål hvor man kan svare fra 1 (ingen interesse) til 7 (meget interesseret). Den anden kategori bestemmer på tilsvarende hvor relevant den studerende finder faget statistik, mens den tredje kategori måler, hvor meget forberedelse de studerende bruger på faget.

	1	2	3	4	5	6	7
Goals							
I would like to improve my ability to analyze quantitative data							
At the end of the course, I would like to be able to interpret statistical output							
I am determined to put in an effort to improve my statistical skills							
Relevance							
Statistical understanding is relevant for my course(psychology)							
I will benefit from an understanding of statistical concepts							
Over all, I believe it is important to have knowledge of statistics							
Preperation							
I prepare for lectures							
I prepare for class exercise							
Each week I read the recommended readings							

Figur 6.1. Evalueringsskema uddelt efter 4 ugers undervisning

Der blev også lavet en midtvejsevaluering af kurset. Her blev der spurgt til de studerendes forberedelsestid, samt hvor relevant, pædagogisk, kvalificeret og velstruktureret de fandt undervisningen. Fra midtvejsevalueringen er det specielt forberedelsestiden og hvor relevant, de finder kurset, der kan belyse om nogen af tiltagene lykkedes. Det var også muligt at komme med personlige kommentarer til undervisningen. De umiddelbart brugbare spørgsmål så ud som følgende:

I den første undersøgelse var der som forventet en stærk sammenhæng mellem, hvorvidt den studerende fandt kurset relevant, mængden af forberedelse og interessen i at blive bedre til statistik. Altså en sammenhæng mellem Relevanc og Goals og en sammenhæng mellem Preperation og Goals. Figur 6.3 viser disse sammenhænge, der i overensstemmelse med det forventede er stærkt signifikant. Af figuren fremgår det, at hovedparten af de studerende gerne vil blive bedre til statistik. Medianværdien for goals er på 5.3. Tilsvarende finder de fleste af de studerende kurset relevant, hvor der også er en medianværdi på 5. Derimod er median værdien på forberedelse kun på 3. Der er altså delvist lykkedes at overbevise de studerende om, at faget er relevant og har sin berettigelse, eller at det er en fordel at kunne

2. Hvor mange timer bruger du i gennemsnit om ugen på dette fag(udover undervisningen)?				
0-1 timer	1-2 timer	2-4 timer	4-6 timer	6 timer eller mere

3. Undervisningen er relevant, dvs.	Meget uenig	Enig	Neutral	Uenig	Meget Uenig
Er rettet mod fagets kompetenceprofil					
Dækker indholdet som beskrevet i fagets beskrivelse i studieordningen					
Er tilstrækkelig rettet mod at forberede eksamen					
Dækker pensum for faget i rimeligt omfang					

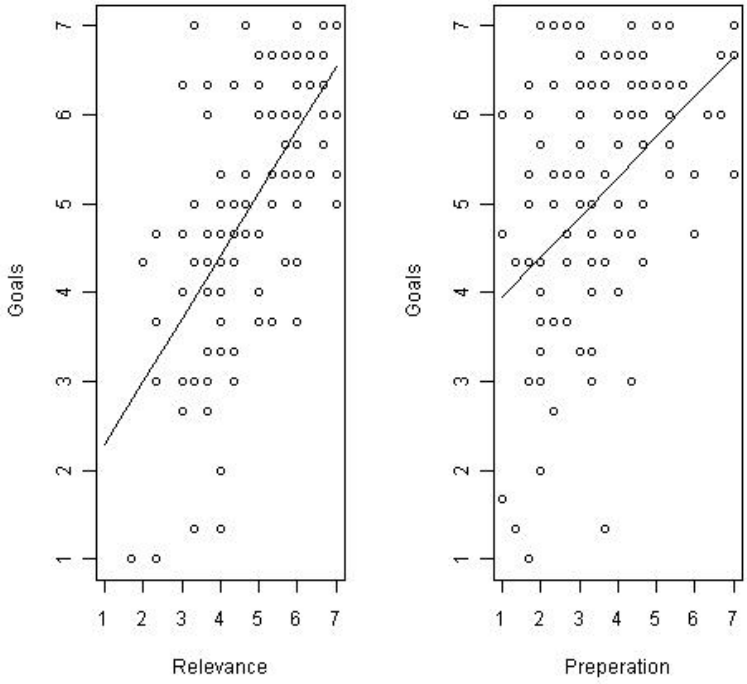
Figur 6.2. Uddrag af spørgsmål fra midtvejsevalueringen

analysere og fortolke kvantitative data. Dette er en stor ændring i forhold til tidligere år. Denne indsigt har de studerende imidlertid ikke ladet påvirke deres arbejdsindsats, der med en median på tre lader en del tilbage at ønske.

I den anden undersøgelse genfindes resultatet, at de studerende bruger for lidt tid på dette kursus. I alt havde 119 besvaret spørgeskemaet. Heraf krydser 95 studerende altså 80 % af i de to første bokse. De brugtes dermed maksimalt to timer på forberedelse. Længere nede i spørgeskemaet kunne de studerende afgøre, om de selv mente, at de forberedte sig tilstrækkeligt til undervisningen. Her var hovedparten enten neutrale (34 %) eller uenige (42 %) i udsagnet, at de forberedte sig tilstrækkeligt. Det gælder altså i høj grad om at få de studerende til at arbejde mere med pensum. Endelige var der også nogle spørgsmål til relevansen af kurset. Her kan det godt være lidt uklart om de studerende har tolket ordet "fag" i bred forstand (psykologi) eller snævert til dette kursus (statistisk). Her får vi en rimelig fordeling af scores som det fremgår af Figur 6.4. Heraf fremgår det, at de studerende primært er enige i de fire udsagn, alternativt forholder de sig neutrale. Disse besvarelser understøtter i høj grad, at der er sket en fremgang i de studerendes opfattelse af faget i forhold til tidligere år.

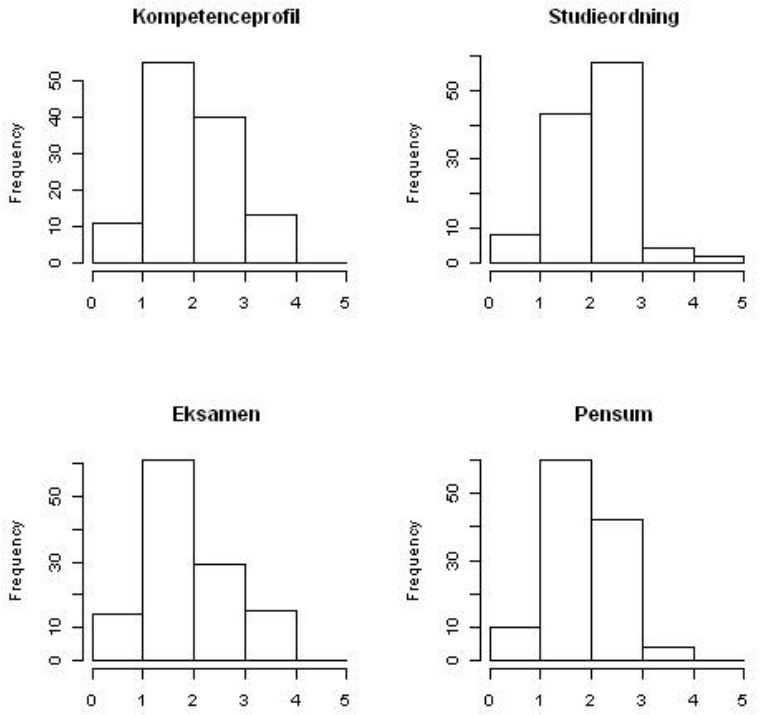
Problemer med afholdelse af Elementær Statistik 2010

I afholdelsen af ES-psy i 2010 var der flere problemer. Det største problem var, at en anseelig del af de studerende lagde en uacceptabel lille indsats i



Figur 6.3. Sammenhæng mellem henholdsvis relevans og forberedelse og den studerendes ønske om at blive bedre til statistik.

forberedelserne, hvilket blev understøttet af de to kursusevalueringer. Flere studerende har aldrig fået købt undervisningsmaterialet. Dog har de studerende gjort mig opmærksom på, at væsentlig flere har købt bogen i år end tidligere. Holdundervisningen har lidt under, at mange studerende møder op til undervisningen uden at have orienteret sig i det materiale, der bliver gennemgået. Selv i den sidste af 12 holdtimer var der en studerende, der ikke var klar over, at kurset har en hjemmeside på trods af, at det er her, al undervisningsmaterialet ud over bogen findes. Da kurset delvist bestås ved fremmøde til holdundervisningen var der meget uro i disse timer, for-



Figur 6.4. Histogrammer over besvarelser på fire underspørgsmål til, hvor relevant de studerende finder kurser.

di studerende møder op uden at koncentrere sig om undervisningen. Den manglende motivation har formentlig været kernen i problemet. Beståelse af dette kursus har ikke stillet krav om læring, men kun om tilstedeværelse. Kombineret med den ringe motivation og forståelse for faget har det formentlig været hovedgrunden til de ringe statistikkundskaber, som kom frem under fokusgruppeinterviewet til forprojektet.

Til forelæsningerne, hvor der ikke er mødepligt, var der et stort frafald. I høj grad fordi de studerende ikke mener, at de får noget ud af at komme til disse timer. Hvilket fremgik af midtvejsevalueringen. Det giver proble-

mer i holdtimerne, hvor de studerende efterspørger det, forelæsningerne prøver at gøre: give en oversigt over pensum og binde det sammen med det, de tidligere har lært. Udover at forelæsningen også gennemgår og forklare teksten. Til holdtimerne kan man så vælge at bruge den begrænsede tid på at gennemgå disse elementer (som altså er planlagt i forelæsningerne) eller gennemgå de planlagte opgaver. Hvis man vælger at give en oversigt over pensum kan det være til irritation for de studerende, der har været til forelæsninger og forberedt sig til øvelsestimerne. Vælger man at ignorere problemet og forsøge at gennemgå opgaverne, hægter man en større andel studerende af ved timens start.

Strukturelle ændringer til næste år

På baggrund af de erfaringer jeg har gjort med kurset i år, er der flere ting, der vil blive ændret næste år efter aftale med studienævnet. Det gælder dog primært for den praktiske afholdelse af kurset. Målsætningerne vil være det samme. For at fremme motivation kan materialet forbedres, men for at fremme læringsprocessen og få de studerende til at tage ansvar for egen læring har jeg planlagt noget strukturelle ændringer. For at gøre kurset mere overskueligt for de studerende vil de næste år blive præsenteret for følgende plan for de 12 ugers undervisning: se figur 6.5.

	Uge 1	Uge 2	Uge 3	Uge 4
Blok 1	Forelæsning (2x45) Øvelser (3x45)	Forelæsning (2x45) Øvelser (3x45)	Forelæsning (2x45) Øvelser (3x45)	Opsamling (2x45) Computerøvelser (3x45)
Blok2	Forelæsning (2x45) Øvelser (3x45)	Forelæsning (2x45) Øvelser (3x45)	Øvelser (3x45)	Opsamling (2x45) Computerøvelser (3x45)
Blok 3	Forelæsning (2x45) Øvelser (3x45)	Forelæsning (2x45) Øvelser (3x45)	Øvelser (3x45)	Opsamling (2x45) Computerøvelser (3x45)

Figur 6.5. Plan for de 12 ugers undervisning.

Faget vil altså fremstå som inddelt i tre ens strukturerede blokke. I hver blok arbejder vi med et tema indenfor statistikken. Pensum i de enkelte blokke vil være, som angivet i figur 6.6.

De to første blokke afsluttes med en større afleveringsopgave. Opgaven afleveres i blokkens sidste uge (4). Kurset afsluttes med en fire timers skriftlig eksamen.

Blok 1: Deskriptiv statistik, analyse af kvantitative variable
Blok 2: Varians og regressionsanalyse af kvantitativ variable
Blok 3: Diskrete data.

Figur 6.6. Pensum i de enkelte blokke.

Tidligere har de studerende som nævnt bestået kurset ved 75 % fremmøde og ved at få godkendt nogle opgaver. Denne eksamensform stiller i højere grad krav til tilstedeværelse frem for læring. Ved at indføre en individuel fire timers skriftlig eksamen vil dette ikke længere være en taktik, der sikrer bestået. Dermed håber jeg, at få de studerende til at deltage mere aktivt i specielt holdundervisningen. Eftersom det stadig er et krav for bestået, at man møder op til holdundervisningen, vil det være rimeligt at stille krav om, at de studerende deltager aktivt i holdtimerne. Dette er også blevet accepteret af studienævnet, men det er endnu ikke fastlagt, hvordan det skal udmøntes. Det kunne eksempelvis ske ved, at man i løbet af hver blok skal fremlægge en del af en ugeopgave ved tavlen. Fremlæggelse er et effektivt redskab, dels er det en god øvelse at fremlægge sit arbejde, dels tvinger det de studerende til at lave arbejdet rimelig grundigt. Sideløbende kan der stilles krav til, at man har læst og overvejet de planlagte ugeopgaver. I holdtimen bliver man inddelt i grupper efter, hvilke dele af opgaven man fandt svær. Hvis man ikke har læst opgaven, kan man ikke blive inddelt i en gruppe og dermed ikke få sit "deltaget i undervisningen-kryds". Ved disse ydre krav for bestået indføres meget extrinsic motivation. Formålet er dog, at ved det skulle fremme de studerende læringsprocess, hvorved den indre motivation skulle opstå.

Udover den skriftlige eksamen vil en anden forskel næste år være, at holdtimerne bliver sat op fra to til tre timer. Det er valgt fordi, det hovedsageligt er her, de studerende lærer faget. Den ekstra undervisningstime øger kontakten med de studerende, og der kan arbejdes med ugeopgaver på en anden måde. En anden forskel er computerøvelserne. Fra næste år vil der være tre øvelsesgange ved computere. Der vil være tre uger til at blive fortrolig med de statistiske begreber og analysemetoder, og dette arbejde afsluttes med at bruge begreberne og metoderne i større datasæt i noget standard statistik programmel. De studerende får også mulighed for at bruge computeren som hjælpemiddel da de bliver fortrolige med den tidligere i kurset. Hovedsagen er dog, at de studerende på det tidspunkt, hvor de

sidder foran computeren, vil være fortrolig med statistikken. Dermed har de overskud til at koncentrere sig om at få computeren til at beregne det relevante og efterfølgende orientere sig i og fortolke output.

Et element de studerende har været glade for i år, er afleveringsopgaverne. Mange studerende har gjort opmærksom på, at de har lært meget ved disse og kunnet se fagets relevans ved udarbejdelsen af disse. Opgaverne har bestået i aktivt at arbejde med pensum ved at læse en artikel baseret på en større statistisk analyse af noget datamateriale. Udover at læse og forstå artiklen har de studerende også skulle regne videre på dele af data. Den del bevares og optimeres i sin nuværende form.

Med indførelsen af en individuel skriftlig eksamen næste år bliver de studerende nødt til at arbejde aktivt med hele pensummet. For at binde eksamen sammen med resten af kurset kunne den skriftlige eksamen tilrettelægges, så den minder om afleveringsopgaverne. Der er ikke tid til, at de studerende læser og behandler en artikel til en fire timers prøve, men opgaven kunne formuleres med udgangspunkt i en relevant artikel. En kort tekst ledsaget af tabeller og grafer fra artiklen kunne ridse opgaven op, der så kunne bestå i at regne videre på data samt fortolke og formidle resultaterne. For at lette rettearbejdet kunne en del af eksamen blive stillet som multiple choice.

Forelæsningsrækken ændres også lidt. Hver blok afsluttes med en opsamling – efterlæsning. Her er der muligt at afklare problemer der har voldt de studerende vanskeligheder inden for det givne modul. Disse timer kan også bruges til at give de studerende et overblik over, hvor kurset er på vej hen. Samtidigt bliver der indført en friuge, hvor der ikke er nogen forelæsning. Dette giver tid og mulighed for refleksion og et pusterum for de studerende, som også vil kunne indhente tidligere forsømmelser. En friuge vil nok ikke være mulig i den første blok, da jeg regner med at skulle bruge en stor del af den første forelæsning til at introducere faget. I lyset af hvordan det er gået i år, vil det være vigtigt at afsætte god tid til at få afstemt forventninger til faget og til deres arbejdsindsats. I den første forelæsning vil jeg altså bruge tid på at fortælle de studerende, hvordan kurset kommer til at forløbe og specielt informere om, hvordan holdtimerne kommer til at køre. Derudover er den første forelæsning også vigtig for at retfærdiggøre hele kurset. Her skal jeg i høj grad vise, at det har en værdi at erhverve sig den viden kurset repræsenterer og, at det ikke kun drejer sig om at bestå den skriftlige eksamen.

Den skriftlige eksamen vil forhåbentlig få de studerende til at tilegne sig pensum mere aktivt end tidligere. De øvrige ændringer håber jeg også

vil fremme den aktive læringsproces i løbet af semesteret. Studienævnet har accepteret alle ovenstående ændringer. På sigt vil jeg dog gerne arbejde med at få integreret faget i de store hovedfag som: kognition, udviklingspsykologi, personlighedspsykologi osv. En mulighed er at dele faget i to dele. For at bevare aktiv deltagelse i den første del skulle denne være undervisningen samt en skriftlig eksamen. Men afleveringsopgaverne skulle afskaffes i deres nuværende form og i stedet knyttes til hovedfagene. I samtlige fag er der afleveringsopgaver, disse kunne så være todelte. Hvor den ene del var statistisk. Denne del skulle så rettes separat. Ved at informere de studerende om, at de umiddelbart skal bruge faget i næste eller nuværende semester i et hovedfagene vil det formentlig fremme motivationen til at arbejde aktivt med faget.

Del II

Course development

7

Kursusudvikling med fokus på dybdelæring

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Indledning

Projektet omhandler planlægning af et nyt fælleskursus (7,5 ECTS) på Fødevarevidenskabsuddannelsen. Kurset skal tilbydes for studerende på 3 år i bacheloruddannelsen eller på kandidatniveau og skal være af et højt fagligt niveau. Kurset med navnet "Molecular Food Science" skal være det første vi udbyder i vores faggruppe som skal fokusere på problembaseret læring, hvor de studerende i grupper ved hjælp af specifikke "fødevarecases" skal lære stoffet. En "fødevarecase" svarer til en temaopgave, der har fokus på aktiv deltagelse og feedback, som beskrevet af Grønbæk & Winsløw (2004), og er et format der fremmer dybdelæring. Kurset vil bestå af 5 temaopgaver, der indeholder problemstillinger af kemisk og fysisk art under produktion, emballering og lagring af en specifik fødevare. Da besvarelsen af temaopgaverne danner grundlag for eksamensspørgsmål forventes de studerende at være motiverede til at arbejde selvstændigt hermed. Underviserens rolle bliver meget mere en vejledningsrolle med en undervisningsform baseret i dialogisk undervisning om de forskellige temaopgaver. De studerende skal i høj grad "undervise hinanden" ved at præsentere deres temaopgaver løbende og give konstruktiv feedback på de andres temaopgaver. Tanken med opgaverne er at de studerende selv skal finde den ønskede viden gennem litteratursøgninger (med vejledning i det omfang det er nødvendigt), og at underviserne enten inden eller efterfølgende supplerer op med den viden som de ikke har været undervist i før. I undervisningen vil der suppleres med korte cases for at underbygge læringsprocessen. Temaopgavernes besvarelser skal afleveres i

poster-format og 1-3 hold (afhængig af antallet af tilmeldte kursusdeltagere) præsenterer på skift deres postere. Underviseren giver feedback på de præsenterede postere og alle har i løbet af kurset mulighed for at genaflevere deres postere. Erfaringsmæssigt er der en del udenlandske studerende på overbygningskurserne, og de har normalt ikke så meget erfaring med selvstændigt projektarbejde og mundtlige oplæg men er derimod oplært i skriftlig eksamen og tests. Temaopgave 3 besvares derfor i en test på Absalon med både generelle, lukkede spørgsmål og åbne spørgsmål, der er mere produktspecifikke. Således vil også e-værktøjer til formativ understøttelse af læring blive udnyttet i undervisningen. Temaopgave 1-4 er ens for alle grupper af studerende, mens de selv skal definere indhold og hypoteser i temaopgave 5. Graden af åbenhed i temaopgave 1-4 øges løbende, så de studerende er rustet til selv at definere problemstillingen til den 5. del, som således er specifik for den enkelte gruppe.

Problemformulering

Projektet omfatter planlægning af et nyt kursus baseret på brug af pædagogiske principper, der ikke tidligere har været anvendt på afdelingens kurser. Problembaseret læring ønskes anvendt som bærende element i kurset. Projektet vil indeholde en overordnet kursusbeskrivelse med mål og indhold som skal indgå i studiehåndbogen. Derefter vil de centrale elementer i kurset blive overvejet og der udarbejdes et eksempel på en ugeplan. Det vil overvejes hvordan de studerende skal arbejde med de forskellige dele af stoffet for at nå kursets mål, hvornår de studerende skal bruge hvilke arbejdsformer, og hvordan summative og formative evalueringsformer inddrages i kurset. Der vil udarbejdes to cases, som skal kunne rumme stoffets kompleksitet.

Kursusbeskrivelse

Uddrag af kursusbeskrivelsen er vedlagt som Appendix A, og under udarbejdelse heraf er Blooms taxonomien anvendt for at fremme en dyb læring (Damberg et al.; 2006; Biggs & Tang; 2007). Under planlægning af kurset er indholdet i kursusbeskrivelsen udnyttet for at sikre "constructive alignment", således at der er overensstemmelse mellem kursets indhold, studenteraktiviteter samt eksamen. De læringsmål (ILOs), der er defineret i kursusbeskrivelsen, er udnyttet under hver temaopgave og der er henvist til dem i denne rapport.

Kursusplan

Kurset består af 5 temaopgaver. Temaopgaverne indeholder de faglige emner beskrevet i kursusbeskrivelsen som inddelt herunder, og er således skrevet på engelsk.

Temaopgave 1: Råvarer og forarbejdede fødevarer
Physics and chemistry of color and pigments in foods, light induced chemical reactions and photo chemistry in foods, chemical toxicology.
Aflevering: poster.

Temaopgave 2: Fødevareingredienser
Moisture sorption, glass transition, stickiness and texture in dry products, novel products like functional food and probiotics, carbohydrate chemistry.
Aflevering: poster.

Temaopgave 3: Emballering, generelt
Gas and water vapor permeability, optical properties, migration, solubility of gases in foods, water migration in foods, modified atmosphere packaging.
Aflevering: test.

Temaopgave 4: Lagring og produktspecifik emballering
Protein oxidation, physics and chemistry of color and pigments in foods, light induced chemical reactions, modified atmosphere packaging, carbohydrate chemistry, chemical toxicology.
Aflevering: poster.

Temaopgave 5: Forsøgsdesign
Her opsamles alle temaopgavernes emner, da de studerende skal udnytte den viden de har opnået i løbet af kurset til at besvare sidste temaopgave.
Aflevering: poster.

Kursusplanen vises i figur 7.1. De korte dage bruges som konfrontationstimer (markeret med fed), hvor de studerende på skift præsenterer deres temaopgaver (postere). Antallet af hold der præsenterer deres postere afhænger af antallet af kursusdeltagere. De lange dage bruges til gruppearbejde og/eller undervisning.

	1. uge		2. uge		3. uge		4. uge	
8.00-12.00	Intro til kurset	GA: TO1	**TO1-afl. 1-3 hold præsenterer**	GA: TO2	**TO2-afl. 1-3 hold præsenterer**	UV: TO3	**TO3-afl. 1-3 hold præsenterer**	GA: TO4
12.30–16.30		GA: TO1		UV: TO2		UV: TO3		GA: TO4

	5. uge		6. uge		7. uge		8. uge	
8.00-12.00	**TO4-afl. 1-3 hold præsenterer**	UV: TO4	**Intro til TO5 Små eksempler på opgaver**	GA: TO5	**TO5-afl. af problem-stilling Alle hold præsenterer**	GA: TO5	**TO5-afl. 1-3 hold præsenterer**	Mulighed for gen-aflevering af alle TO'ere
12.30–16.30		GA: TO4		GA: TO5		GA: TO5		

	9. uge
8.00-16.30	**Eksamen: Præsentation af poster + pensum**

Figur 7.1. Kursusplan (forkortelse: GA = gruppearbejde, UV = undervisning, TO = temaopgave)

Uddybende beskrivelse af kursets indhold

Introduktion til kursusforløb

Introduktion til kurset er en præsentation af kursets struktur, herunder

- betydningen af og meningen med temaopgaverne
- gruppearbejde i kurset
- skabelon til poster
- individuel genaflevering af alle temaopgaver
- eksamensformen der benyttes i kurset
- appetitvækker til kurset samt hvilke forventninger underviserne har til de studerende
- bibliotekets hjælp til litteratursøgning

Appetitvækkeren til kurset kunne være en humoristisk beskrivelse af undervisningsformen samt de forventninger underviserne har til de studerende, og skal også være med til at personificere underviserne, som f.eks. appetitvækkeren til kurset Mikroøkonomi af Bramsen (2009). Formålet med dette er at oplyse de studerende om de forventninger kurset stiller til dem samt komme eventuelle problemstillinger om kursusstrukturen i forkøbet.

Introduktion til temaopgaverne

Temaopgaverne i dette projekt er inddelt i ILOs fra kursusbeskrivelsen (og er derfor skrevet på engelsk) og i selve opgaven, der udleveres til de studerende. Det er tilstræbt at formulere temaopgaverne som problemorienterede cases. Derudover er der til sidst i hver temaopgave tilføjet nogle faglige og undervisningsmæssige overvejelser, som er skrevet i kursiv idet denne tekst ikke afleveres til de studerende. Der er udarbejdet et eksempel på temaopgave 1, 4 og 5, mens temaopgave 2 og 3 ligeledes skal konstrueres. I denne rapport handler både temaopgave 1 og 4 om kød, da dette er vores fælles speciale, men alternativt kunne temaopgave 1 omhandle mejeriprodukter for at få en bedre spredning mellem produkter.

Temaopgave 1: Råvarer og forarbejdede fødevarer

En enkelt underviser er hovedansvarlig for temaopgaven

ILOs (fra kursusbeskrivelsen)

- Use chemical food science knowledge to evaluate the stability of a certain food product.
- Relate knowledge about chemical reactions in food to the quality of food.
- Assess the stability of a food product.
- Illustrate and discuss analytical data understandably and thoroughly.
- Communicate the obtained knowledge in writing.
- Present and discuss the outcome of the project work.
- Cooperate with fellow student on a project and exercises.

Case om farve af kød og kødprodukter: omdannelse af farvede pigmenter

A. CarneTec Gourmet er en virksomhed, der leverer frosne oksekødsbøffer til gode restauranter. Når bøfferne skal bruges optøs de på køl og pakkes ud et øjeblik før de steges. Nu har virksomheden imidlertid modtaget klager fra kokkene der ikke kan lide udseendet af de optøede bøffer inden stegning. De frosne bøffer er røde i indpakningerne før optøning, men efter at bøfferne er tøet op, bliver de brune i vakuumpakningerne. De er også brune efter pakningen er brudt og bøfferne har været udsat for luft.

Et konkurrerende firma leverer frosne bøffer, der har en mørkere rødviolet farve, når de er vakuumpakket. Efter optøning er bøfferne stadig rødviolette i vakuumpakningen og når vakuumpakningen brydes "bloomer" bøfferne til en rød farve inden kokkene steger bøfferne.
CarneTecs' arbejdsprocedure:

- Bøffer skæres i 2-3 cm tykkelse og får lov til at "bloome" til de får en rød farve.
- De røde bøffer vacuumpakkes.
- Vacuumpakkerne nedfryses hurtigt til -35C (indenfor 5 min).
- Bøfferne sælges til restauranter.

Spørgsmål:

1. Hvilke myoglobinpigmenter er til stede i hhv. CarneTec's og konkurrentens frosne bøffer?
2. Hvorfor er CarneTecs bøffer brune efter optøning?
3. Hvordan kan CarneTec ændre deres procedure eller timing af proceduren for at undgå at den brune farve dannes og få kødet til at "bloome" (danne den røde farve) når vakuumpakningen er brudt?

B. PÅLÆGNU, et producent af pålægsprodukter, henvender sig til dig for at få hjælp til at undersøge et nyt pålægsprodukt. Hensigten er at sammenligne det gode gamle kogte skinkepålæg med en "tilsætningsfri" kogt skinke, dvs. uden tilsætning af nitrit i saltlagen. I det nye pålægsprodukt er den direkte tilsætning af nitrit erstattet med grøntsagspulver. Grøntsager indeholder betydelige mængder nitrat, som kan blive reduceret til nitrit af den naturlige mikroflora i kødet. Der bliver opsat et lagringsforsøg over 90 dage, hvor der måles følgende parametre: udviklingen af farve, tilbageblivende mængde af nitrat og nitrit samt sensorisk bedømmelse. Det skal vurderes om det nye pålægsprodukt er et godt alternativ til det nitritholdige produkt.

Spørgsmål:

1. Hvilken effekt har nitrit og nitrat på farven i kogt skinkepålæg?
2. Påvirker dette tilsætningsstof andet end farven af skinken?
3. Påvirker tilsætning af grøntsagspulver andet end farven?
4. Er det det samme pigment der dannes i kogt skinkepålæg og i lufttørret skinke, f.eks. Parma skinke?
5. Overvej hvordan det udleverede datasæt kan præsenteres på den bedst mulige måde (i form af figur eller tabel og forklarende figur-/tabeltekst), og hvordan det kan inddrages i besvarelse af spørgsmålet.

Besvarelsen af casen skal præsenteres på en poster, hvor I vil få feedback af underviseren. Hvis I derudover er udvalgt til at præsentere casen i plenum til konfrontationstimen, skal I medbringe jeres poster elektronisk og forberede jer på at præsentere den. I har mulighed for at genaflevere jeres poster hvis I synes den skal forbedres efter konfrontationstimen.

Spørgsmålene i denne temaopgave er lukkede. Her forventes en beskrivelse af myoglobins farvecyklus og at de studerende kan anvende denne viden til at besvare spørgsmålene i casen. Der forventes desuden en beskrivelse af det lyserøde pigment der skyldes dannelse af nitrosylmyoglobin på denatureret form. Den konserverende og den toksikologiske effekt af nitrit skal overvejes. Forskellen mellem denatureret nitrosylmyoglobin, ikkedenatureret nitrosylmyoglobin og Zn-protoporphyrin skal beskrives. Nitrit har også en konserverende effekt (inhibering af gram-negative bakterier som Clostridium botulinum) og bidrager positivt til produktets kødaroma. Så tilsætning af nitrat har både positive og negative effekter. Under præsentationen af temaopgave 1 skal underviseren supplere op med eventuel manglende viden om Zn-protoporphyrin. Det udleverede datasæt er baseret på det ovenfor nævnte lagringsforsøg og har til formål at træne de studerende i at lave overskuelige og pæne figurer, der er lette at tolke for læseren. Underviseren giver dem feedback på udseendet af figurerne, så de til temaopgave 4 er blevet bedre til at lave figurer.

Præsentation af casen skal foregå i plenum for 1-3 af holdene (afhængig af kursusdeltagerantal) med feedback fra underviser og medstuderende. Denne første temaopgave skal besvares ret tidligt i kurset, hvor de ikke har haft særlig lang tid til forberedelse, så det er mest tænkt som en opsummering af tidligere kendt viden for at få dem i gang med temaopgaverne.

Temaopgave 2: Fødevareingredienser

En enkelt underviser er hovedansvarlig for temaopgaven

ILOs:

- Use chemical food science knowledge to evaluate the stability of a certain food product.
- Relate knowledge about chemical reactions in food to the quality of food.
- Assess the stability of a food product.
- Illustrate and discuss analytical data understandably and thoroughly?
- Communicate the obtained knowledge in writing.
- Present and discuss the outcome of the project work.
- Cooperate with fellow student on a project and exercises.

Case om probiotiske bakterier

Her forestiller vi os en case tilsvarende temaopgave 1, men blot med de problemstillinger der er for en fødevareingrediens som frysetørrede probiotiske bakterier. I denne temaopgave er der mere fokus på de fysiske ændringer i produktet.

Temaopgave 3: Emballering, generelt

En enkelt underviser er hovedansvarlig for temaopgaven

ILOs

- Identify how different packaging atmospheres influence the chemical and microbiological processes in food.
- Describe the interaction between food, packaging, and surroundings including transport and distribution of chemical substances.
- Select the most relevant packaging materials to food products.
- Argument and make a qualified evaluation (based on basic scientific competences) of the influence of different packaging solutions on the quality and safety of food.
- Communicate the obtained knowledge in writing.
- Present and discuss the outcome of the project work.

- Cooperate with fellow student on a project and exercises.

Test på Absalon vedrørende emballagerelaterede problemstillinger

Til temaopgave 3 har de studerende ingen forudsætninger inden kurset, så der indlægges undervisning om emballering, bla. vand-, gas- og lysgennemtrængelighed af emballagetyper, opløselighed af gasser i fødevarer, migration. Undervisningen består af både forelæsninger og teoretiske regneøvelser. Efter undervisningen skal de studerende svare på en individuel test via Absalon, hvor hjælpemidler er tilladt. De første spørgsmål omhandler generelle emballeringsspørgsmål, evt multiple choice (dvs lukkede spørgsmål). Til sidst i testen stilles nogle åbne spørgsmål der er relevante for specifikke fødevarer, som feks:

1. *Hvilke emballagetyper findes til mejeriprodukter i supermarkeder eller kunne være relevante at bruge?*
2. *Hvilke fordele og ulemper kan nævnes ved disse emballagetyper?*

Testbesvarelserne gøres op inden konfrontationstimen. I begyndelsen af konfrontationstimen får de studerende mulighed for at diskutere deres besvarelser indbyrdes i gruppen og 1-3 hold studerende udvælges efterfølgende til at præsentere besvarelsen af testen. Spørgsmålene diskuteres i plenum.

Temaopgave 4: Lagring og produktspecifik emballering

En enkelt underviser er hovedansvarlig for temaopgaven

ILOs

- Identify which chemical reactions are taking place during production and storage of food and relate to consequences for food quality
- Suggest how quality deterioration of a food product may be avoided during production, storage, and by selection of appropriate packaging system.
- Assess the stability of a food product.
- Use analytical data to describe the stability of food.
- Illustrate and discuss analytical data understandably and thoroughly.
- (Argument and make a qualified evaluation (based on basic scientific competences) of the influence of different packaging solutions on the quality and safety of food.)

- Communicate the obtained knowledge in writing.
- Present and discuss the outcome of the project work.
- Cooperate with fellow student on a project and exercises.

Case om oxidation i kød under lagring i forskellige pakkeatmosfærer

Du er ansat i en virksomhed, hvis produkter er primært fersk kød og marineret, fersk kød. Alle kødprodukter er centralpakket i modificeret atmosfære (80% O_2/20%CO_2) og efterfølgende sendt til supermarkederne. Du har modtaget forbrugerklager vedrørende smag og lugt af flere sendinger af kødprodukter, som beskrives som "ikke kødagtig" og "harsk" samt mindre mørt og saftigt end konkurrerende produkter, der er vacuumpakkede. Kølelinien er blevet checket med temperaturloggere og den ønskede temperatur i kølelinien er blevet overholdt. Teksturen af kødet forud for pakning er blevet undersøgt og resultaterne viser "forventet og normal" teksturintensitet.

Hvordan vil du håndtere dette problem for at sikre kundernes tilfredshed med din virksomheds produkter?

1. Start med at karakterisere kød i forhold til proteinindhold og -sammensætning, indhold af mættet/umættet fedt, samt pro- og antioxidanter.
2. Overvej om hypervalente myoglobinformer dannes i kød og foreslå i så fald hvordan hypervalente myoglobinformer kan påvirke oxidation af lipider og proteiner i kød.
3. Hvilke kvalitetsforringelser sker der i kød under lagring?
   a) Er der en kobling mellem lipid- og proteinoxidation i kød?
   b) Hvilke kvalitetsforringelser er forårsaget af proteiner i kød?
4. Hvilke faktorer påvirker disse kvalitetsforringelser?
5. Hvordan kan disse kvalitetsforringelser minimeres?
6. Overvej hvordan det udleverede datasæt kan præsenteres på den bedst mulige måde og hvordan det kan inddrages i besvarelse af spørgsmålet.

Besvarelsen af casen skal præsenteres på en poster, hvor I vil få feedback af underviseren. Hvis I derudover er udvalgt til at præsentere casen i plenum til konfrontationstimen, skal I medbringe jeres poster elektronisk og forberede jer på at præsentere den. I har mulighed for at genaflevere jeres poster hvis I synes den skal forbedres efter konfrontationstimen.

Spørgsmålene i denne temaopgave har varierende grad af åbenhed. De studerende ledes fortsat i den retning vores undervisning omhandler, men svarene på spørgsmålene er endnu ikke helt afklarede, så de studerendes besvarelser vil afhænge af den litteratur de finder og hvor dygtige de er til at koble egen viden med litteraturstudier. De studerende har allerede kendskab til lipidoxidation i fødevarer, så her fokuseres på proteinoxidation. Det udleverede datasæt er baseret på data fra et eksperiment om proteinoxidation i kød.

Præsentation af casen skal foregå i plenum for 1-3 af holdene (afhængig af kursusdeltagerantal) med feedback fra underviser og medstuderende.

De studerende har ikke haft meget undervisning i proteinoxidation, så vi forventer ikke at de har overvejet denne problemstilling så detaljeret. Derfor er der indlagt undervisning i proteinoxidation efter denne konfrontationstime. Denne undervisning (af en hel formiddag) tilrettelægges efter hvor fyldestgørende præsentationerne til konfrontationstimen har været. Efter undervisningen er der tid til gruppearbejde på temaopgave 4 igen, så de studerende får mulighed for at forbedre besvarelserne.

Temaopgave 5: Forsøgsdesign

Alle undervisere er ansvarlige for temaopgaven.

Her opsamles alle temaopgavernes emner, da de studerende skal udnytte den viden de har opnået til at besvare sidste temaopgave.

ILOs

- Explain how detrimental chemical reactions may be analyzed in a food sample
- Solve problems on food quality deterioration arising during production and storage including selection of an appropriate packaging solution.
- Argument and make a qualified evaluation (based on basic scientific competences) of the influence of different packaging solutions on the quality and safety of food.
- Present a food quality problem and a suggested solution.
- Communicate the obtained knowledge in writing.
- Assess the stability of a food product.
- Select, describe, and illustrate the essence of a food quality problem and solutions to overcome this problem.
- Present and discuss the outcome of the project work.

- Cooperate with fellow student on a project and exercises.

Introduktion
I er lige blevet ansat på et forskningscenter som nyudklækkede kandidater. I bliver løbende præsenteret for problemstillinger fra fødevareindustrien vedrørende fødevarekvalitet, som farve, smag, lugt og tekstur, og I skal hjælpe industrien med at løse disse problemer. I arbejder i et team på 3 personer.

Efter I har været ansat i 6 måneder bliver der afholdt et stort fagligt møde på forskningscenteret, hvor projektmidler prioriteres og fremtidige indsatsområder udvælges. Derfor skal I, med baggrund i den viden I har opnået i løbet af ansættelsen, udvælge en problemstilling og planlægge et forsøg, der skal udarbejdes under jeres vejledning og som besvarer den problemstilling, som I har valgt at undersøge. Problemstillingen samt forsøgsplanen skal præsenteres på det faglige møde i form af en poster. I skal derfor i løbet af jeres ansættelse få kendskab til hvilke analysemetoder der kan bruges til at evaluere forskellige relevante kemiske kvalitetsændringer i udvalgte fødevarer. I har laboranter til at udføre alt det praktiske arbejde, så I skal ikke selv lave analyserne, men I skal kunne tolke resultater opnået ved disse metoder.

1. Formuler en titel og den problemstilling I ønsker at undersøge.
2. Beskriv hvordan forsøget skal sættes op.
3. Overvej hvilke analysemetoder der skal benyttes.
4. Hvilke resultater forventer I at opnå udfra forsøget?
5. Hvordan kan dette bruges for den virksomhed du er ansat i?

Punkt 1 skal præsenteres af alle grupper til næste konfrontationstime og diskuteres i plenum sammen med underviserne.

Den samlede besvarelse af temaopgave 5 skal præsenteres på en poster, hvor I vil få feedback af underviseren. Hvis I derudover er udvalgt til at præsentere casen i plenum til konfrontationstimen, skal I medbringe jeres poster elektronisk og forberede jer på at præsentere den. I har mulighed for at genaflevere jeres poster hvis I synes den skal forbedres efter konfrontationstimen.

Her definerer de studerende selv deres opgave i form af en titel og problemformulering (eller hypotese der skal testes) til poster'en, så denne opgave er meget åben. Arbejdet med temaopgave 5 starter med en introduktion til hvilke typer opgaver de studerende kan lave samt eksempler

herpå. Derefter er der indlagt tid til gruppearbejde og til næste konfrontationstime skal titlen samt problemformuleringen/hypotesen godkendes af underviseren, så indholdet i opgaven bliver bred nok i forhold til pensum og så grupperne ikke bare vælger et allerede publiceret forsøg. Her kan det overvejes om de studerende skal opfordres til at forsøget skal give nye ikke-publicerede resultater, eller om det er tilstrækkeligt at forsøget blot dækker allerede kendt viden. Dette kunne de studerende også selv bestemme. Der er afsat tid til diskussion af problemformuleringen med underviserne i den første konfrontationstime til temaopgave 5, så de uambitiøse studerende udvider deres problemformulering og de over-ambitiøse studerende får afgrænset deres problemformulering.

Det er ikke meningen at alle postere skal indeholde lagringsforsøg. Spørgsmål 5 kan sagtens omhandle andet end lagring af fødevarer, som f.eks. kemiske modelforsøg. De studerende skal være i stand til selv at udvælge analysemetoder til at undersøge problemstillingen samt overordnet kunne planlægge et forsøg, der besvarer de spørgsmål de opstiller, og som der er arbejdet med i temaopgaverne 1-4.

Evaluering

Der benyttes både formativ og summativ evaluering i kurset. Den formative evaluering sker løbende under temaopgave-præsentationerne mens den summative evaluering foregår til eksamen.

Formativ evaluering

I kurset fokuseres der meget på litteratursøgning, selvstændigt arbejde (i grupper) og diskussion af viden for at forberede de studerende på det kommende specialeprojekt. Hvis de studerende ikke har fundet tilstrækkelig dækkende litteratur til besvarelsen af en temaopgave, supplerer underviseren med dette. Pensum består af det litteratur de studerende finder, det der suppleres op med fra underviserne, og som er centralt for de overordnede kemiske emner der indgår i kurset beskrevet i kursusbeskrivelsen. Hvor meget de studerende går i detaljer med de enkelte områder er op til dem selv, men underviserne skal sørge for at de holder fokus og er brede nok i deres besvarelser. Underviserne på de enkelte temaopgaver har ligeledes en vejlederrolle. Det er ikke meningen at vejlederrollen skal være en fuldtidsopgave, men man skal indregne noget forberedelsestid inden kurset går

i gang så man er i stand til at være deltagende i gruppernes præsentationer, give konstruktiv feedback og kende til det centrale litteratur der findes på området. Vejlederne på kurset skal have en fælles opfattelse af hvordan der skal vejledes. De studerende skal f.eks. selv finde litteratur, men vejlederen må gerne kommentere på om det fundne litteratur er det mest centrale og dækkende og må også gerne hjælpe med at prioritere litteraturen hvis de studerende har fundet meget frem.

Summativ evaluering

Alle 4 postere (temaopgave 1, 2, 4 og 5) er eksamensspørgsmål, der kan trækkes til eksamen. Testen i temaopgave 3 indgå i de generelle spørgsmål til resten af kursets indhold. Poster'ne for temaopgave 1, 2, 4 og 5 samt testen for temaopgave 3, der er udarbejdet i løbet af kurset, skal genafleveres individuelt til den kursusansvarlige. Alle studerende har dermed mulighed for at forbedre besvarelserne enten individuelt eller i grupper.

Eksamen er baseret på 5 minutters mundtlig præsentation, 15 minutters spørgsmål til den trukne temaopgave samt 5 minutters generelle spørgsmål til resten af kursets indhold (samlet 20 minutter). Der afsættes 10 minutter til karaktergivning samt "buffer". Alle 5 temaopgaver er pensum og den studerende trækker en af sine egne besvarelser af temaopgaverne (1, 2, 4 eller 5) som eksamensspørgsmål. De studerende får 30 minutters forberedelsestid efter de har trukket eksamensspørgsmålet.

Konklusion

Det har ikke været muligt at afprøve kurset med deltagelse af studerende endnu, da det først bliver udbudt i 2011 for første gang. Dog er visse dele af temaopgave 1 og 4 afprøvet i et eksisterende kursus med studerende fra samme niveau som forventes at følge "Molecular Food Science". Spørgsmålene blev inddraget i en forelæsningssituation, hvor den nødvendige viden blev gennemgået først, og niveauet af opgaverne viste sig at være lidt for lette. I "Molecular Food Science" bliver opgaverne stillet uden forudgående faglig introduktion, og derfor menes det at niveauet er passende. Det må dog forventes at kursets faglige niveau skal tilpasses efterhånden. Derfor er det yderst vigtigt at der etableres en god dialog med de studerende allerede i opstarten af kurset, så de motiveres til at evaluere kurset grundigt.

I den præsenterede kursusstruktur er undervisningen primært problembaseret og der udnyttes både formativ og summativ evaluering. De studerende motiveres ved at alle temaopgaver kan trækkes som eksamensspørgsmål, og dybdelæring opnås ved aktiv deltagelse af de studerende og feedback fra underviser. Kursusbeskrivelsens ILOs er ligeledes formuleret for at opnå dybdelæring, og de er anvendt og udnyttet under udarbejdelsen af temaopgaverne for at sikre "constructive alignment". Som underviser på dette kursus, vil det være lettere at følge de studerendes læring og afhjælpe hvor det er nødvendigt i forhold til på et kursus, der anvender den traditionelle forelæsningsstruktur.

A Kursusbeskrivelse

Molecular Food Science - 270023

Details

Department of Food Science	
Earliest Possible Year	BSc. 3 year to MSc. 1 year
Duration	One block
Credits	7.5 (ECTS)
Course Level	Joint BSc and MSc
Examination	Final Examination Oral examination based on presentation of poster Some Aid allowed Description of Examination: Examination is based on a poster presentation and oral examination in project content and course curriculum. The students are individually examined in the course curriculum on the basis of questions formulated with starting point in the poster presentation. Weight: Oral examination in project and curriculum 100% 7-point scale, internal examiner
Requirement For Attending Exam	Participation in the excursions and group-based project work. Handing in and approval of poster.
Organisation of Teaching	Lectures, seminars, exercises/demonstrations and excursions. Work load and distribution will change from week to week.
Block Placement	Block 4 Week Structure: A
Teaching Language	English
Optional Prerequisites	Some skills in mathematics, knowledge in physical chemistry, Fødevarekemi or knowledge in basic food chemistry, , Physical and chemical changes in food quality or corresponding knowledge, experience in project work and report writing
Restrictions	None

Course Contents

Is an advanced food chemical course based on cases of specific food products

Applied Molecular Food Science
Advanced food chemistry such as protein oxidation, carbohydrate chemistry, light induced chemical reactions and photo chemistry in foods. Moisture sorption, glass transition, stickiness and texture in dry products. Solubility of gases in foods. Water migration in foods. Chemical toxicology. The physics and chemistry of color and pigments in foods.

Properties of Packaging Materials
Gas and water vapor permeability. Optical properties. Migration.

Cases of food products
Cases involving applied food chemistry and packaging. Modified atmosphere packing. Cases involving specific products like meat, cheese, dry products and beer. Novell products like functional food and probiotics. Food chemical problems arising in relation to product development.

Teaching And Learning Methods

Lectures with a general overview of the subject are presented. Workshops on specific topics, where the students are required to participate actively. Lectures and workshops are given by both external experts and internal staff covering both fundamental and applied topics. Theoretical exercises that elaborate and illustrates the theoretical knowledge by using scientific and real world examples. Practical examples or demonstrations will introduce important experimental aspects from real life and industry. Excursions to relevant producers. Project based learning where groups of students are required to identify and explain the most important food chemical aspects, methods of analysis for evaluation of these aspects, and suggest packaging solution(s) to a specific food product. The work results in a poster presentation.

Learning Outcome

The main objective of the course is to give the students a general knowledge of food as chemical systems and the derived practical consequences for the quality of food during production and storage including selection of packaging system. After completing the course the student should have the ability to:

Knowledge:
Use chemical food science knowledge to evaluate the stability of a certain food product;
Identify which chemical reactions are taking place during production and storage of food and relate to consequences for food quality;
Explain how these detrimental chemical reactions may be analysed in a food sample;
Use analytical data to describe the stability of food;
Suggest how quality deterioration of a food product may be avoided during production, storage and by selection of appropriate packaging system;
Identify how different packaging atmospheres influence the chemical and microbiological processes in food;
Describe the interaction between food, packaging and surroundings including transport and distribution of chemical substances;
Select the most relevant materials to food products;

Skills:
Relate knowledge about chemical reactions in food to the quality of food;
Solve problems on food quality deterioration arising during production and storage including selection of an appropriate packaging solution;
Argument and make a qualified evaluation (based on basic scientific competences) of the influence of different packaging solutions on the quality and safety of the food;
Illustrate and discuss analytical data understandably and thoroughly;
Present a food quality problem and a suggested solution;
Communicate the obtained knowledge in writing.

Competences:
Assess the stability of a food product;
Select, describe and illustrate the essence of a food quality problem and solutions to overcome this problem;
Present and discuss the outcome of the project work;
Cooperate with fellow students on a project and exercises

8

Integrating project work in an applied statistics course

Christian Pipper

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Introduction

As the new course director of the PhD course in applied statistics "Mixed Linear Models" at LIFE I decided on a major restructuring of teaching material and teaching activities to get a better alignment to the intended learning outcomes (ILOs).

One of my ideas was to actively use that this is a project course. That is, the course is intended – and expected by the students – to give them the competencies to justify, generate, and report statistical statements and conclusions so that they can answer relevant research questions on their own data. As such the students are for the most part highly intrinsically motivated (Biggs & Tang; 2007, p. 34) when focus is on their projects. I wanted to construct TLAs that promoted this motivation into deep learning in a *theory Y climate* as described in (Biggs & Tang; 2007, chapters 2-3).

To specifically channel student enthusiasm about their own data into in depth reflection on course material and ensure an optimal foundation for their project work in terms of gaining the above competencies, I constructed a self-reflection exercise for each of the 5 course days.

The self-reflection exercises consisted of questions helping the students to gain operational skills with their data, prompting them to reflect on important parts of the teaching material in relation to their own data, and guiding them through the process of writing a project synopsis that could function as a recipe of how they were to produce their project. As a built in part of the exercise the students were to present and test their ideas and discuss their progress and problems in pairs.

The student opinions on these exercises were evaluated by a questionnaire scoring the content, structure, and gain of the exercises.

Course description and specific TLAs

Course contents

The course covers basic theory and applications of mixed models, that is models having both fixed effects (as in ordinary linear regression or ANOVA models) and random effects. In addition these models may also have serial correlation structures, which are often useful in the context of repeated measurements/longitudinal data. The main focus is models for continuous response, but mixed models for categorical response are also briefly introduced. Operational skills for analyzing mixed models is based on the statistical programming language **R**.

Overall structure and some facts

The teaching sessions of the course take place on 5 whole days and are followed by a one month supervised project period. The project period is completed by a final whole day session where the students in turn present and discuss their projects.

In 2010 12 PhD students from various areas of bio-sciences at the University of Copenhagen attended the course. They were given 6 ECTS credit for completing the course.

Teaching material

The course material has been structured so that all concepts and methods have been illuminated and materialized by data-examples from research projects within agriculture/veterinary science/epidemiology. This goes for exercises as well as they all evolve around aspects of the statistical analysis of a concrete data-example. The examples have been chosen to cover research areas of typical students and thereby hopefully appear relevant to the students.

Specific TLAs

- **Summaries from previous day:** Student teacher discussion of concepts from the previous day. The product is a white-board overview of important concepts
- **Student presentation of exercises:** Students present a computer exercise and report their findings. Followed by questions from other students and student teacher discussion.
- **Student seminar sessions:** Based on a subject specific teacher written essay the students in pairs of two lecture over a subject. Each essay contains a number of open questions that form the basis of a classroom discussion.
- **Lectures:** Power-point presentations of general theory and concepts accompanied by student teacher discussion.
- **Computer exercises:** Analysis of data-examples by means of the statistical programming language **R** as well as interpretation and reporting of results. Supervised by teacher.
- **Self-reflection exercises:** The students relate course contents to their own data and discuss their findings with other students and teacher.
- **Project supervision:** Each student is entitled to two 1 hour supervision sessions with the teacher during the project period. Before each session the student sends an email with concrete questions to deal with at the session.
- **Project presentation:** 15 min oral student presentation of project followed by 5-10 min discussion with teacher and other students.
- **Project feedback:** Written evaluation/feedback from teacher on final project.

More information about the course

Additional material can be found on the course home-page:
http://www.matfys.kvl.dk/stat/phdcourses/mixed/

The structure and content of the self-reflection exercises

This section focuses on describing the actual self-reflection exercises in terms of their ingredients and progression. In this context extracts of the

actual exercises are included in italic to exemplify concepts. The exercises in their full length can be found in Appendix A.

Each of the four first self-reflection exercises begins with an introduction advocating the purpose and gain of the exercise:

"This exercise is intended to give you time to reflect on and discuss the structure of your own data. Such exercises will also be present on the other course days and are intended to guide you through the process of deciding on an analysis strategy for your own data."

This is followed by guide-lines on how much time to use for the questions and student discussion. For instance the guidelines for the first course day were:

"You should use approx 15 min. to consider the questions below and then taking turns use approx 10 min. each to discuss your answers and considerations with the course-participant next to you."

The actual content of the exercise is then presented in the form of 1 to 3 questions directly related to student data. For instance on day 1 the questions were:

1 *Make a short description of your data.*
2 *Concisely state the one most important research question related to your data.*
3 *Consider and justify ways of stating this research question in terms of outcome and explanatory variables.*

Closely linked to the progression of the course I tried to induce the following flow in the four first self reflection exercises

- **Day 1:** Make a concrete link between research question and data. Exercise duration 25 min.
- **Day 2:** Make a strategy for getting data into **R**. Describe data in terms of quantitative/qualitative /random variables as a first step towards a statistical model. Exercise duration 45 min.
- **Day 3:** Get data into **R** based on strategy from day 2. Attempt to formalize research question and data design into a first shot at a mixed linear model. Exercise duration 75 min.
- **Day 4:** Develop an analysis strategy for the chosen model with emphasis on the consequences of the strategy in terms of results and reporting. Exercise duration 75 min.

The self-reflection exercise on the 5th day of the course consists of tying together the previous 4 self-reflection exercises into a project-synopsis that

may form the basis of the project work to come. Two hours are allocated for working on this exercise. The project synopsis is motivated and described in the exercise as follows:

A synopsis or analysis plan is a much used tool in statistical project work. It's purpose is three-fold

- *It is usually the product of a combined effort of several parties constituting an agreement on the justification and purpose of the specific statistical procedures to be used in the project.*
- *It is a recipe to follow for the person to do the actual analyses and as such it provides overview and induces efficiency in the analysis process.*
- *Several parts of the synopsis can be reused in the process of reporting the results in terms of for instance a paper.*

Usual contents of a synopsis

- *A concise data description*
- *Research objectives/questions*
- *Description of chosen statistical methods.*

Evaluation of self-reflection exercises

Student evaluation

The students were asked to anonymously score the following questions from 1 to 5 with 1 meaning "I don't agree at all", 3 meaning "I agree", and 5 meaning that "I agree totally".

- **Content:** The self-reflection exercises provided a good opportunity for me to relate the course material to my own data
- **Structure:** The self-reflection exercises provided a good forum for discussion of my own data
- **Gain:** The self-reflection exercises helped me in the process of producing a project synopsis

The questions are part of the questionnaire used for overall evaluation of the course which is presented in Appendix B along with a graphical overview of the results. In the resulting student evaluations, question specific average scores were analyzed by a robust GEE approach (Liang & Zeger; 1989) taking into account within person correlation. All analyses were made in **R** version 2.10.1 (www.r-project.org).

The questionnaires were completed by 8 of 12 students. The average scores for the above 3 questions relating to the content, structure, and gain were: 4.1 (3.5-4.7), 4.3 (3.6-4.9), and 3.9 (3.1-4.6). There was no significant difference in average scores due to specific questions (p-value=0.14 (Robust Wald test)). The overall average score for the self-reflection exercises was 4.1 (3.4-4.7).

Additional student comments about the self-reflection exercises were

- Did the self-reflection exercises at home. Didn't think there was time during 13-16
- Very good course, great to work with own projects. Plenty of time for questions.

The evaluations indicate that the students are in general very satisfied with all aspects of the self-reflection exercises.

My evaluation

It is my observation that the students use the self-reflection exercises very differently. In this respect the students may be grouped into 3 different categories

- The time allocated for the exercise is mostly used to look at aspects of own data, largely disregarding the structure and content of the specific self-reflection exercise.
- The time allocated for the exercises is mostly used to look at aspects of own data, largely respecting the structure and content of the specific self-reflection exercise.
- The time allocated for the exercise is largely used to look at the computer exercises instead.

For the first two categories these exercises are very motivational and I sense that for many of these students they constitute the high-light of the day. I have also noted that the students obeying the structure and content of the exercises gain a lot from this. In addition to the student pair discussions I had very constructive short discussions with most of the students about their data during the time allocated for the self-reflection exercises. The students neglecting the structure and contents of the exercise prefer to discuss their data with me which leads to minor outbursts of frustration as I can not engage in the 10-15 minute discussion they are intended to have with another student.

A few students focus solely on digesting the course material of the day in terms of using all the time allocated for exercises on the computer exercises. I find this to be a constructive and natural choice as they were in fact struggling with the concepts in the course material and in seen this light I can respect that they have no additional capacity for the self-reflection exercises.

Concluding remarks

Based on my own observations and student evaluations I would have to conclude that the self-reflection exercises have been a very positive addition to the course in terms of project integration and achievement of course ILOs.

This of course does not mean that self-reflection exercises are a context-free recipe for success as they require student data of a high enough quality and complexity to make the process of completing the self-reflection exercises – and learning complicated statistical methods – worth-while for the student. However, it is my experience that the vast majority of PhD students attending these types of Applied Statistics Courses have data-examples and research questions fulfilling these requirements.

Also the success of the self-reflection exercises ideally requires the course material to cover a wide range of data-examples, so that a sound analysis of student data is exemplified in the course material. This approach was successfully adopted in the present course where students on average scored their agreement with the statement *"The examples were relevant to my field of research"* to 3.5 (2.6-4.4) (see Appendix B).

Another problematic aspect of the self-reflection exercises in the specific context of this course was that a substantial fraction of the students neglected the actual structure and content of the exercises and thus attacked their data in a rather unstructured manner. I find this a pity as I noted how the students who followed exercises more stringently benefited from it. During the course this problem was discussed with my pedagogical supervisor, who suggested that I emphasize the importance of structuring statistical project-work – which is really what the self-reflection exercises are all about – by including it as an ILO. I shall definitely adopt this suggestion next time I give the course. Yet another possible solution to this problem, that would be worthwhile trying out, is to formally pair the stu-

dents for these exercises, perhaps even on the basis of similarities in their projects.

A Appendix: The 5 self-reflection exercises

Day 1

This exercise is intended to give you time to reflect on and discuss the structure of your own data. Such exercises will also be present on the following course days and are intended to guide you through the process of deciding on an analysis strategy for your own data.

You should use approx 15 min. to consider the questions below and then taking turns use approx 10 min. each to discuss your answers and considerations with the course-participant next to you.

1 Make a short description of your data.
2 Concisely state the one most important research question related to your data.
3 Consider and justify ways of stating this research question in terms of outcome and explanatory variables.

Day 2

This exercise is intended to give you time to reflect on and discuss the structure of your own data. Such exercises will also be present on the other course days and are intended to guide you through the process of deciding on an analysis strategy for your own data.

You should use approx 30 min. to consider the questions below and then taking turns use approx 15 min. each to discuss your answers and considerations with the course-participant next to you.

1 Develop a strategy for getting your data into **R** and if possible try it out. Identify the problems you encounter and think of a solution.
2 Determine which of your explanatory variables are qualitative and which are quantitative. Would **R** agree with you?
3 Which of your variables would you consider random? Why?

Day 3

This exercise is intended to give you time to reflect on and discuss the structure of your own data. Such exercises will also be present on the other course days and are intended to guide you through the process of deciding on an analysis strategy for your own data.

You should use approx 60 min. to consider the assignments below and then taking turns use approx 15 min. each to discuss your answers and considerations with the course-participant next to you.

1 Work further on getting your data into **R** and customize them to your needs within **R**
2 Prepare a small presentation of your data and your research question
3 Consider the possibility of assessing your research question in terms of a linear mixed model. What model would you use? How would you shed light on your research question within this model? Do you foresee any problems with the model fit?

Day 4

This exercise is intended to give you time to reflect on and discuss the structure of your own data. Such exercises will also be present on the other course days and are intended to guide you through the process of deciding on an analysis strategy for your own data.

You should use approx 60 min. to consider the assignment below and then taking turns use approx 15 min. each to discuss your considerations with the course-participant next to you.

- Elaborate further on a statistical strategy for answering your research questions in terms of models, hypotheses, and quantification. You may be inspired by the analysis of the Hibiscus data at the final lecture today.

Day 5

In this exercise you are intended to tie together your work from the previous 4 self reflection exercises in writing a synopsis on your project as described below. You should use approximately 2 hours for making the synopsis.

The idea of the synopsis

A synopsis or analysis plan is a much used tool in statistical project work. It's purpose is three-fold:

- It is usually the product of a combined effort of several parties constituting an agreement on the justification and purpose of the specific statistical procedures to be used in the project.
- It is a recipe to follow for the person to do the actual analyses and as such it provides overview and induces efficiency in the analysis process.
- Several parts of the synopsis can be reused in the process of reporting the results in terms of for instance a paper.

Usual contents of a synopsis

- A concise data description
- Research objectives/questions
- Description of chosen statistical methods.

B Appendix: Questionnaire for student-evaluation

About the evaluation

This questionnaire is meant to provide feedback on the teaching activities and course material used during the course in terms of your perception of their quality and relevance. The feedback will be used to optimize both teaching material and teaching activities in terms of providing the best possible circumstances for guiding future students through the process of producing statistically founded quality statements and conclusions for their projects. As such your honest and critical feedback is much appreciated by me.

You should anonymously rate your agreement on each of the statements in the questionnaire from 1 to 5 with 1 meaning ”I don’t agree at all” and 5 meaning that ”I agree totally”. Also further comments on your part are most welcome and there is made room for these as well.

	Not at all		Agree		Totally
	1	2	3	4	5
Course material					
The methods and concepts in the course material (slides, essays, exercises) were justified by examples					
The focus on examples in the course material aided my understanding of methods and concepts					
The examples were relevant to my field of research					
The examples were interesting in general					
The general quality of course material was high					
Comments on course material:					
Teaching activities					
The quality of the lectures was high					
There was a good forum for discussion and questioning at the lectures					
The quality of the student seminar sessions was high					
There was a good forum for discussion and questioning at the student seminar sessions					
My own student seminar presentation helped me get a better understanding of the material I presented					
The quality of the computer exercises was high					
I got appropriate and constructive feedback at the computer exercises					
The self-reflection exercises provided a good opportunity for me to relate the course material to my own data					
The self-reflection exercises provided a good forum for discussion of my own data					
The self-reflection exercises helped me in the process of producing a project synopsis					

	Not at all		Agree		Totally
	1	2	3	4	5
There was a good balance between lectures, student seminar sessions, computer exercises, and self-reflection exercises (Please comment this statement if you don't agree)					
Comments on teaching activities:					
The course in general					
I feel confident that I have obtained the necessary competencies to justify, generate, and report statistical statements and conclusions in relation to my course project					
I feel confident that I have obtained the necessary competencies to justify, generate, and report statistical statements and conclusions in relation to other projects I might encounter					
General comments on the course:					

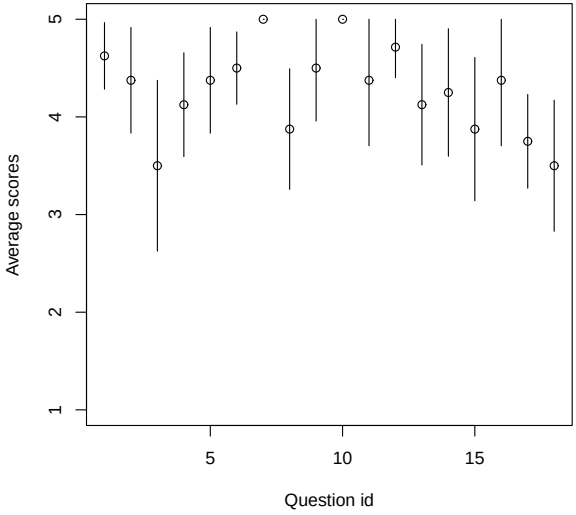

Fig. 8.1. Question specific average scores of agreement (1=not at all, 3=agree, 5=agree totally). Vertical lines correspond to 95% confidence intervals.

9

Pædagogiske udfordringer ved undervisning i (fagets) videnskabsteori

Christian Gamborg

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Indledning

"Fagets Videnskabsteori – Landskabsarkitektur og Bydesign" (400029) er et obligatorisk kursus på bacheloruddannelsen i Landskabsarkitektur og Bydesign (pt. på 1. studieår, blok 3). Jeg har stået for udvikling, planlægning, undervisning, evaluering og eksamen, siden det blev oprettet i dets nuværende form i 2006. Der er pt. ca. 65 studerende tilmeldt kurset.

Iflg. kursusbeskrivelsen er formålet med kurset "...at introducere de studerende til at se og forstå deres fag og de tilhørende videnskabelige discipliner i et alment perspektiv. De studerende bliver introduceret til de vigtigste erkendelsesmæssige og værdimæssige antagelser, der ligger til grund for genstand, teori og metode inden for landskabsarkitektur og byplanlægning."

Forhistorien er – kort fortalt – for denne type kurser, at indtil 1971 skulle alle universitetsstuderende indlede deres studium med et filosofi-kursus kaldet Filosofikum. Ifølge aftalen mellem undervisningsministeren og rektorkollegiet i 2001 om indførelse fagets videnskabsteori, skal denne type kursus tjene til at vise faget i "et større alment perspektiv". Væsentlige formål med kurset – set i forhold til de generelle uddannelsesretninger er, at kurset skal have grundlag i uddannelsens/fagets forskning, være med til at modvirke tendensen til specialisering (dvs. have blik for den store sammenhæng ens færdigheder indgår i) samt bidrage til at forbedre dialogen mellem eksperterne og det samfund, eksperterne skal fungere i. Det centrale er, at Fagets Videnskabsteori altså ikke er endnu en faglig specialitet

– men giver den studerende forskellige perspektiver på den *eksisterende* faglighed.

Kurset er i høj grad et kursus, som stiller spørgsmål om de studerendes uddannelse og deres fagområde, om den viden, der bliver skabt inden for deres fagområde(r), og hvordan den viden bliver brugt og endelig spørgsmål om de værdier, der indgår i faget. Det nævnte kursus er bygget op over tre centrale dele: Faget selv (hvad er landskabsarkitektur og bydesign), erkendelse (hvordan skabes ny viden) og værdier (hvordan håndteres værdispørgsmål). Disse dele udforskes gennem en række temaer:

- *Faget selv*: Hvad er landskabsarkitektur og bydesign? Hvad er videnskabsteori? Hvad er videnskab?
- *Erkendelse*: Naturvidenskabelige tilgange, samfundsvidenskabelige tilgange, humanistiske tilgange
- *Værdier*: Centrale begreber, æstetik og natursyn, etik: Hvilke hensyn skal fremmes, hvad er forholdet til det omgivende samfund?

Det er målet, at kurset skal give de studerende mulighed for at (1) *gennemskue deres fag*, dvs. genkende de dele, deres fagområde er bygget op af og kunne se faget i en større sammenhæng, (2) *diskutere deres fag*, dvs. opnå en større grad af faglig selvforståelse, og endelig (3) *blive bedre til faget*, dvs. ved at (videre)udvikle sin kritiske sans. Spørgsmålet er så, hvordan det så sker bedst rent læringsmæssigt?

Problemformulering

Ved hjælp af et eksempel (kurset 400029 "Fagets Videnskabsteori – Landskabsarkitektur og Bydesign") vil dette projekt analysere de pædagogiske udfordringer, der er ved dette kursus og i lyset af disse udfordringer pege på studenterfokuserede læringsmåder og didaktiske overvejelser, der kan være med til at forbedre læringsudbyttet for de studerende.

Som det bliver sagt i en af forelæsningerne på kurset, er der langt fra fænomenologi til landskabsarkitektur. Spørgsmålet er derfor, hvordan en egnet læringsproces kan udformes, så den redeligt får overbragt essensen af forskellige videnskabsteoretiske (herunder etiske) aspekter ved fagområdet landskabsarkitektur og bydesign, men på en måde så teorien giver mening i forhold til det anvendte det fagområde?

Hvilke pædagogiske udfordringer er der *qua* indhold, dvs. stofområdet og de studerendes faglighed og forudsætninger? Hvilke pædagogiske ud-

fordringer er der *qua* undervisningsform, dvs. hvilken læring (overfladisk/dybde) tilskyndes, og hvilken rolle spiller holdstørrelsen?

Derudover vil projektet redegøre for de centrale læringsmål for kurset samt hovedelementerne til at opnå dette (litteratur – forelæsninger – (gruppevis) diskussion – øvelser – opgaver – eksamen), herunder begrunde valget af de forskellige undervisningssituationer, der indgår. Projektet berører desuden vigtigheden af "constructive alignment", altså hvordan der bedst muligt skabes overensstemmelse mellem undervisning og eksamen.

Hvad skal de studerende lære på kurset– og hvordan?

Hvis man ser på landskabsarkitekt- og bydesignuddannelsens kompetencebeskrivelse på bachelordelen, er den delt op i tre dele: grundvidenskabelige kompetencer, kompetencer inden for teknik og produktion, og *kompetencer vedr. etik og værdier*. I forhold til sidstnævnte er det meningen med uddannelsen ifølge studiebekendtgørelse, at "... de studerende [skal udvikles] til fagfolk, der kan reflektere over, hvilken betydning udøvelsen af deres erhverv har i et bredere samfundsmæssigt og etisk perspektiv. Dvs. studerende der [a] grundlæggende forstår problemstillinger knyttet til menneskets udnyttelse af naturressourcerne, herunder bæredygtighedsbegrebet, [b] har grundlæggende kendskab til og respekt for demokratiske beslutningsprocesser, [c] grundlæggende forstår betydningen af den menneskelige dimension i udviklingen af det fysiske miljø – som er opmærksom på, at beslutninger om det fysiske miljø vedrører menneskers liv, [d] kan reflektere over egen videnskabelige og faglige praksis, herunder reflektere over egne løsningsforslag og være opmærksom på, at der ofte kan være flere rigtige svar på et problem [og e] har respekt for andres arbejde, viden, holdninger og kultur.

Det er i forhold til det sidste kompetencefelt, at kurset 400029 Fagets Videnskabsteori særligt kan forventes at bidrage, men indirekte er postulatet, at det også – gennem at øge de studerendes kritiske sans – bidrager til de opfyldelsen af de andre kompetencer. Betydningen af forskellige syn på landskab og by, og hvad natur er, fremhæves i kurset. Desuden diskuteres mere indgående æstetikbegrebets rolle, f.eks. hvilken status æstetiske vurderinger har, og hvilken rolle æstetik spiller i forbindelse med design og forslagsstillelse i krydsfeltet mellem at være indbygget, men ikke entydig, norm og kvalitetsparameter og rent 'smagsdommeri'. Eksempler på planlægnings- og landskabsrelaterede etiske og andre værdimæssige problemstillinger analyseres. Endelig diskuteres landskabsarkitektur og by-

planlægning i et samfundsmæssigt perspektiv, herunder bæredygtighedsbegrebet, for at give de studerende bedre mulighed for at gennemskue kontroverser af betydning for faget og reflektere over landskabsarkitektens og byplanlæggerens rolle i forhold til resten af samfundet. Der er således på den ene side et rent *forståelses*element i Fagets Videnskabsteori (i de to første mål) samt et mere *instrumentelt* sigte (via det sidste og til dels sidste mål). Hvad der mere konkret betyder det i forhold til opnåelse af viden, færdigheder og kompetencer fremgår af figur 9.1.

Viden:

- Redegøre for etiske teorier
- Redegøre for centrale videnskabsteoretiske begreber
- Identificere etiske og videnskabsteoretiske problemstillinger i faglige sammenhænge

Færdigheder:

- Anvende etiske teorier på en relevant faglig problemstilling
- Diskutere betydningen af centrale videnskabsteoretiske begreber
- Analysere fagtekster inden for landskabsarkitektur og bydesign samt videnskabsteoretiske tekster med henblik på at afdække indhold, argumenter, antagelser og bagvedliggende værdier
- Formidle faglige, etiske og videnskabsteoretiske problemstillinger klart på skrift og mundtligt

Kompetencer:

- Være i stand til på selvstændig, kritisk og konstruktiv vis at indgå i en værdibaseret debat om faglige emner
- Arbejde selvstændigt med analyse af faglige tekster
- Arbejde effektivt sammen med andre om formidling af etiske og videnskabsteoretiske problemstillinger

Figur 9.1. Viden, færdigheder og kompetencer, som det er målet, at den studerende skal opnå ved at følge kurset 400029 Fagets Videnskabsteori for Landskabsarkitektur og bydesign, KU, LIFE.

Det væsentlige er, at de studerende er i stand til at se sit eget fagfelt i et såkaldt alment perspektiv, dvs. er i stand til at udpege og diskutere de vigtigste erkendelsesmæssige og værdimæssige antagelser, der ligger

til grund for genstand, teori og metode inden for landskabsarkitektur og byplanlægning.

De ovenstående mål er delvist operationelle. I sagens natur er der en stor grad af rummelighed i en række af de begreber og teorier, som kurset handler om (etiske teorier, værdibaseret debat, videnskabsteori). Det er dog operationelt i den forstand – og understøttes af de to opgaver, de studerende udarbejder i løbet af kurset – at de kan gengive udvalgte etiske teorier og udvalgte tilgange til det at bedrive videnskab. De to opgaver – samt øvelser undervejs i kurset – træner også den studerende til at *anvende* disse teorier på en faglig problemstilling inden for deres fagfelt. I den ene opgave forsøger de at se på indhold, budskab, argumenter og antagelser i en faglig tekst. I den anden opgave vælger de selv en faglig problemstilling og forsøger at tage debat om de bagvedliggende værdispørgsmål. Til eksamen skal de dels redegøre (altså den første del nævnt) for teorien og dels kunne forholde sig til brugen af teorien på en konkret, faglig problemstilling.

Pædagogiske udfordringer

I forbindelse med Fagets Videnskabsteori er der en række pædagogiske udfordringer, der dels er knyttet til indholdet og dels til den didaktiske situation:

A. Indholdsmæssigt (1) stofområdet er stort (erkendelsesteori såvel som værdispørgsmål), (2) stofområde er generelt vanskeligt tilgængeligt, og (3) der er (meget) langt fra teorien til (anvendelse i) praksis.

B. Didaktisk (4) de studerende har ikke væsentlige forudsætninger for at arbejde med dette stof – og på denne måde (vant til (gruppebaseret) tegnesalsundervisning, projektarbejde og -vurdering), (5) Det er et (relativt) stort hold, ca. 65.

Med hensyn til A – det indholdsmæssige (1), spænder et fagområde som landskabsarkitektur og bydesign vidt med hensyn til *arbejdsfelt* – fra by til det åbne land; fra formgivning til forvaltning – og favner tillige bredt med hensyn til *teoretiske diskussioner*. Det er et fagområde, som bygger på traditionel naturvidenskabelig viden, f.eks. i forbindelse med planters krav til voksested og økologi, samfundsvidenskabelig viden, f.eks. i forhold til planlægnings- og driftsopgaver, og helt klart har dele, der bunder i humanvidenskaberne, f.eks. æstetik og formgivning. Samtidig er de *værdimæssige aspekter* – her tænkes f.eks. på natursyn og naturetik – særdeles relevante bl.a. pga. det væsentlige element af forslagsstillelse, der er i faget.

Med hensyn til (2) viser erfaringer fra egen undervisning inden for landskabsarkitektur/bydesign samt øvrige videnskabsteorikurser på KU-LIFE, at det tager tid at tilegne sig dette stof, og at en hel del af diskussionerne inden for videnskabsteori enten bliver for omfattende, ikke relaterer sig nok til de mere praktiske aspekter af forskningen – samtidig med at denne problematiseres – eller ikke er helt relevante for at få et første overblik og en kritisk vinkel på sit eget fag.

Med hensyn til (3) kan der f.eks. være meget langt fra landskabsarkitektur til fænomenologi, som den beskrives inden for humanistisk videnskabsteori. En egnet læringsproces skal med andre ord meget præcist 'skæres til', så den redeligt får bibragt essensen af forskellige videnskabsteoretiske aspekter, men så teorien giver mening i forhold til til anvendte fagområde,

En væsentlig pointe med undervisningen i 400029 er, at der gennemgås og forklarer definerende aspekter af *teoretisk stof*, men i størst muligt omfang bruges emner/*eksempler* af central karakter for landskabsarkitektur og bydesign til illustration af teorien (i forbindelse med gennemgang eller umiddelbart efter teoriafsnit). Dvs. på indholdsmæssige side kobler undervisningen de videnskabsteoretiske og værdimæssige diskussioner tæt til relevant fagligt stof.

Med hensyn til B – de didaktiske udfordringer (4), består den undervisningsmæssige udfordring i at få en "passende" balance mellem overflade- og dybdelæring ud fra 1) bredde vs dybde, og 2) anskueliggørelse vs egen forholden. Figur 9.2 viser nogle af spørgsmål, der skal overvejes for at tage denne udfordring op.

Med hensyn til (5) holdstørrelse er forelæsninger (i en 'traditionel' forstand) som påpeget af bl.a. Gibbs (1981) ikke specielt effektive ud fra et studenterlæringsperspektiv; f.eks. er studerende kun meget lidt aktive (75% af tiden går med passiv tænkning), notaterne indeholder kun ca. 20% af det gennemgåede stof, og det er ofte kun den midterste del af en forelæsning, der huskes. Der er derfor behov for måder at bryde dette mønster, hvis ønsket selvsagt er øget læringsudbytte for de studerende Herskin (2001). En frugtbar måde at komme videre på, er at se forelæsningen som en række miniforelæsninger (Jenkins; 1992). Disse miniforelæsninger skal ses som en række segmenter, hvor det selv med større holdsstørrelser er muligt at aktivere de studerende i højere grad. En væsentlig forudsætning for succes er, at en (stor) del af disse segmenter ikke blot er forelæsemonologer, men forelæserstyrede mindre gruppeaktiviteter.

Redskabsfag >< forståelsesfag – er der en modsætning?

- **Uoverskueligt >< Udvandet**
  Passe på, at syn på videnskab (videnskabsteoretiske retninger/tilgange) eller dominerende etiske tankegange ikke bliver for karikerede – men samtidig være i stand til at genkende nogle hovedtræk
- **Uden ophæng >< For brugsrettet**
  Lægge op til overvejelser, der giver mening for de studerende for at forstå det præsenterede stof i sig selv, men samtidig bruge refleksioner mere "instrumentelt" (med fare for forståelsesaspekt nedtones)
- **For lidt kritisk >< Nå at forstå**
  Betone en kritisk forholden til tilgange og metoder, men samtidig nå at forstå tilgange på kort tid

Figur 9.2. Undervisningsmæssige udfordringer – hvilken balance skal man gå efter – i kurset 400029 Fagets Videnskabsteori for Landskabsarkitektur og bydesign, KU, LIFE.

Hvordan kan de pædagogiske udfordringer imødegås?

I Bilag A er det beskrevet, hvordan det i en konkret undervisningssituation om naturbegrebet søges at imødegå nogle af de pædagogiske udfordringer nævnt i det foregående afsnit. Af eksemplet fremgår det, at der i kurset i stigende omfang søges at arbejde *problembaseret*, først i form af en lille "teaser", der kan være abstrakt, men som ofte er konkret og senere i form af en eller flere problemer, der har rod i de studerendes fagområde; landskabsarkitektur eller bydesign.

Det helt afgørende er, at der sker en bevægelse fra én type problem (aktiviteter inden for deres fagområde knyttet til planlægning, forvaltning og formgivning af natur) til et problem med egentlig at definere 'natur' som begreb. Det bagvedliggende pædagogiske formål er, at det dermed vises, at de to problemer (det praktiske og det begrebslige) er forbundne. Den problembaserede undervisning fortsætter så med at spørge: Hvordan løser man så det? De studerende har selv forsøgt at svare på spørgsmålet, og sent undervisningsgangen kommer det 'svar', som dagens tekst giver.

En anden væsentlig pointe fra undervisningseksemplet er, at *øvelsesarbejdet er integreret,* og det er vigtigt, at der sker skift mellem undervisaktivitet og studenteraktiviteter, samt at i forbindelse med disse skift, at det didaktiske miljø bliver overgivet på den rette måde, jf. Biggs & Tang (2007). Konkret sker det i kurset ved, at forelæsninger varieres/integreres med øvelser (i auditorium med fladt gulv). Der sker ved, at der er rige-

ligt med dialog i forelæsningerne – mellem studerende i mindre grupper og mellem underviser og studerende. På den måde opnås også, at de også behersker det stof, de skal lære, mundtligt, hvilken er en fordel, da de går til mundtlig eksamen (hvor der foregår summativ evaluering, dvs. en slutbedømmelse, her med en individuel karakter efter 7-skalaen). Det sker desuden ved, at de studerende selv arbejder med stoffet i flere tempi: læsning, forelæsning, øvelser, forelæsning, nu læsning og opgavearbejde. På opgaven får de konkret feedback, oftest gruppevis, hvilket altså er en formativ evaluering, der sker som en del af løbende evaluering i tæt tilknytning til de mål for undervisningen, der er stillet op, og som skal ses som en væsentlig del af de studerende læring.

I vis forstand kan måden, der arbejdes med i kurset, siges at have haft været en gennemslagskraft – bedømt ud fra de studerendes egen opfattelse af kurset, som det fremgår af den skriftlige og mundtlige kursusevaluering. Kurset er i alle fem år (i den nye form) grundlæggende blevet evalueret meget positivt.[1] Et flertal giver udtryk for at kurset er relevant, spændende og meget velstruktureret med et tilpas fagligt niveau. De lægger i deres evaluering vægt på, at øvelser og opgaver er meget vigtige for læringen. Desuden fremhæves det, at *øvelser, der indgår integreret i undervisningen* samt opgaveskrivning er væsentlige bidrag til indfrielse af læringsmålene. Ved kurset er de studerende meget aktive (på tværs og på trods af holdstørrelser, der har svinget fra 40 til 100(!)). Desuden fremhæves det ved alle evalueringer, at de studerende anser det som meget væsentligt, at de aktiveres gennem i fælles og gruppebaserede diskussioner samt gennem andre studenteraktiverende tiltag.

Endelig kan der peges på, som tidligere nævnt, at kurser som Fagets Videnskabsteori hæfter sig tæt til fagområdet – og derfor skal planlægning koordineres, dvs. at det er afgørende fortsat at inddrage/planlægge i samråd med uddannelsens øvrige lærerkræfter og bygge på faget, hvilket også sker.

Konklusion

Der blev indledningsvist spurgt, hvordan en egnet læringsproces kan 'skæres til', så den redeligt får overbragt essensen af forskellige videnskabsteoretiske (herunder etiske) aspekter ved fagområdet landskabsarkitektur og bydesign, men på en måde så teorien giver mening i forhold til til det anvendte fagområde? Det blev søgt besvaret ved at se på, hvilke pædagogiske

[1] Evalueringer er for omfattende til at vedlægges som bilag, men er tilgængelige på Absalon.

udfordringer der er *qua* indhold og hvilke pædagogiske udfordringer, der er *qua* undervisningsform? Med hensyn til indhold er det kendetegnende for fagets videnskabsteori, at (1) stofområdet er stort (erkendelsesteori såvel som værdispørgsmål), (2) stofområde er generelt vanskeligt tilgængeligt, og (3) der er (meget) langt fra teorien til (anvendelse i) praksis. Med hensyn til didaktik præges faget af, at (4) de studerende har ikke væsentlige forudsætninger for at arbejde med det videnskabsteoretiske stof – og på denne måde vant til (gruppebaseret) tegnesalsundervisning, projektarbejde og –vurdering, (5) Det er (relative) store hold, ca. 65, der undervises.

En central pædagogisk udfordring ved kurset er, hvordan man skaber en "passende" balance mellem 1) bredde og dybde, og 2) anskueliggørelse og 3) den studerendes egen måde at forholde sig til stoffet.

Erfaringen fra de seneste fem års undervisning er, at en læringsmæssigt frugtbar måde at imødegå disse udfordringer er problem- og dialogbaseret undervisning (det sidste er i mindre grad diskuteret ovenfor). En af grundene er, at specielt problembaseret undervisning kan være med til at fremme læringen, fordi det er inden for et fagområde, der i høj grad bygger på, at der stilles (begrundede) forslag til f.eks. et projektforslag, en skitse, en plan i forhold til et givet *problem*. Som nævnt er det afgørende, at der sker en bevægelse fra én type problem (aktiviteter inden for deres fagområde knyttet til planlægning, forvaltning og formgivning af natur) til et problem med egentlig at definere 'natur' som begreb. Det bagvedliggende pædagogiske formål er, at det dermed vises, at de to problemer (det praktiske og det begrebslige) er forbundne.

A Appendix Eksempel fra en undervisningssituation om naturbegrebet, hvor de pædagogiske udfordringer søges imødegået i praksis

Kurset frembyder en række pædagogiske udfordringer, der dels er knyttet til indholdet og dels til den didaktiske situation[2]. Hvordan den undervisningsmæssige udfordring kan imødegås, vises lettest ved en "typisk" undervisningsgang, her med et på én gang ganske konkret og i praksis kendt begreb for de studerende – *'natur'* og på den anden side en ganske abstrakt og mangetydig størrelse.

[2] Dette afsnit bygger på dele af refleksionspapir udarbejdet i forbindelse med supervision.

Læringsmålet for den konkrete undervisningsituation er beskrevet i ILO: "Udbytte af undervisningen (ILO (Intended Learning Outcome)) Efter undervisningen i dag, skal I kunne: (a) Genkende forskellige opfattelser af, hvad natur er, inkl. hvordan man selv bruger natur som begreb, (b) Diskutere naturbegrebers betydning i forhold til landskabsarkitektur og bydesign, (c) Angive, hvad et natursyn er og kunne beskrive og diskutere forskellige natursyn, og (d) Analysere deres rolle i forhold til landskabsarkitektur og bydesignproblemer". Her gengives delen, der har med (a) og (b) at gøre.

Der begyndes med en *"teaser" – et lille problem*, et eksempel, der viser, hvad der er det centrale (hvorfor de studerende skal høre om dagens emne, mv.) fulgt af en kort visning af, hvad litteraturen til dagen er, samt hvilket udbytte de studerende forventes at skulle få af undervisningen. Meningen med dette er, at de studerende kan orientere sig i, hvad der forventes af dem, og måske mere vigtigt, hvordan de skal "sortere" i det stof, der bliver gennemgået/de selv arbejder med i den undervisningsgang. Dernæst er der en kort opsamling fra sidste undervisningsgang. Dette er specielt vigtigt, når der anvendes gæsteforelæsere, at få uddraget en form for essens, nogle vigtige pointer – som måske ikke kom helt klart frem for de fleste i den pågældende, forgangne forelæsning. Desuden er der en tendens til med blokstrukturen, at ting præsenteres én gang, og så er det videre til næste station, næste emne.

I resten af forelæsningen, hvori *øvelsesarbejdet er integreret, er det vigtigt, at der sker skift mellem underviseraktivitet og studenteraktiviteter*. Desuden er det afgørende, at de studerende dels får en fornemmelse af, at de bliver aktiveret, og dels at denne aktivering ikke kommer "som lyn fra en klar himmel", men at det *didaktiske miljø bliver overgivet på den rette måde*, jf. Biggs & Tang (2007). Det væsentlige er derfor at få aktiveret de studerende selv tidligt i forløbet, f.eks. med en lille (opvarmings)øvelse i forhold til ovennævnte forelæsning ("Dan tre ord, hvor 'natur' indgår"). Opsamling sker kort i plenum ved at skrive en række af de dannede ord på tavlen, så alle kan se (hvis de ikke kan høre det f.eks.!), og så det kan fastholdes til senere brug i undervisningsgangen.

Herefter kan der gennemgås stof, i det konkrete tilfælde visuelle eksempler på 'natur' (som dog ikke lige er oplagt for alle, at det alt sammen kan ses som 'natur') og så kort tid efter få fat i en mindre øvelse igen, der skal være med til at skærpe de studerendes opmærksomhed om det, der derefter kommer (nemlig, "hvad er natur?"). I det anvendte eksempel bliver de bedt om selv at forsøge sig med en definition på og forklaring af 'natur' enkeltvis og derefter med sidemanden fremlægge definitionen. De bliver

desuden bedt om at forholde sig til et eller flere af følgende spørgsmål: "Hvad har I haft i tankerne, da I skrev jeres 'definition'? Hvad er modstykket til natur? Er mennesket en del af naturen?" Der samles op i plenum ved at tage nøgleord ud af deres definitioner og føre dem op på tavlen. Her er det vigtigt at spørge ind til, hvad de selv forbinder med den definition, de har fremlagt. Det viser sig ofte, at de ved denne proces selv erfarer, hvor vanskeligt det kan være at sætte ord på en ellers forekommende velkendt begreb ('natur').

Hvis det ikke er nok til at skærpe interessen/læringsmodtagelighed for det, som derefter kommer i undervisningen, *opstilles problemer, der har rod i deres fagområde*: f.eks. "Naturvenlig byplanlægning", "Når naturen plejes", by og natur – modsætninger, og der linkes tilbage til en tidligere øvelse med visning af "Værdien af Amager Strandpark er 4,4". Med disse tiltag er det nu muligt at fremlægge deciderede definitioner af 'natur', forklare hvor mangetydigt begrebet er – dvs. der rykkes fra deres egne definitioner, problemer inden for fagområdet, til problemer inden for selve begrebet (at det er så mangetydigt). Der sker således en bevægelse fra én type problem (aktiviteter inden for deres fagområde knyttet til planlægning, forvaltning og formgivning af natur) til et problem med egentlig at definere 'natur' som begreb, og intentionen er, at det dermed vises, at de to problemer (det praktiske og det begrebslige) er forbundne. *Den problembaserede undervisning* fortsætter så med at spørge: Hvordan løser man så det?

Først nu kommer det "svar", som dagens tekst (af filosoffen Hans Fink) giver – vi kan kategorisere de forskellige begreber om natur og dermed præcisere, hvad vi egentlig mener med natur (f.eks. som det, der er uberørt af mennesker, eller blot som det, der findes uden for byen, eller alt det grønne).

Dernæst aktiveres de studerende igen ved at pege på dilemmaer, som en ikke eftertænkt brug af naturbegreber kan give anledning til, dvs. der *gås fra det abstrakte tilbage til det konkrete* "Hensyn til naturen" – hvad vil det egentlig sige? Eksemplificeret ved en forvaltningsproblematik ved søerne i København vedr. skarvkolonier.

Nogle gange, men ikke den konkrete gang, der refereres til, afsluttes med, at de studerende selv svarer på en række centrale spørgsmål, der er knyttet til de opstillede læringsmål for undervisningsgangen. En anden variant, der benyttes, er at spørge, hvad der var det mest vanskelige eller mest interessante. I det konkrete tilfælde skulle der laves en forbindelse til næste forelæsning/øvelsesgang, der omhandlede natursyn.

10

Case-Based Learning for Declarative Knowledge

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Introduction

In this paper I will report on my experiences with redesigning a first year Economics course for improved learning. I will reflect on my experiences from teaching the same course last year and discuss why I chose to introduce Case-Based Learning as the core Teaching-Learning Activity (TLA). I will briefly describe how I implemented the new activities and spend some time evaluating the outcome.

This is the second year I teach the first year course International Economics on the Agricultural Economics programme at the faculty of Life Sciences, University of Copenhagen. The course is taught in english to a mix of Danish "in-house" students and foreign exchange students (roughly 50/50 mix). Typically around 35-40 students attended the lectures.

Throughout the paper, I draw on the concepts and ideas discussed in Biggs & Tang (2007). Where nothing else is stated, this work should be considered the main reference.

Reflections on last year's experience

International Economics is very theoretical in nature. Its traditional aim is that students should gain knowledge and understanding of a range of different theoretical models explaining why international trade is desirable, what happens when the government conducts trade policy (e.g. imposes

import tariffs) and the role played by exchange rates and international capital movements. Thus, the knowledge to be learned is traditionally viewed as declarative in nature, akin to theoretical courses in the natural sciences, and teaching activities have traditionally involved lecturing combined with tutorials, in which the students are expected to perform various calculations based on the models taught. This is also how I offered the course last year.

Having completed the course last year, I could not escape a feeling of slight disappointment over many of the students' general performance at the final exam. A few students did very well indeed, and not many students did so badly that they failed the course, but still the overall picture was one of generally poorer performance than what I have expected. In fact, when grading the exam papers, I was sometimes shocked to find myself searching for subtle signs that the students were going in the right direction so I could reward them for that, even though their answers were plainly wrong. More than once I wondered whether my expectations were just too high – after all, I had little experience in teaching and evaluating student performance.

There turned out to be a certain pattern in the gap between the students' performance and my expectations. Many students failed to clearly distinguish between the theoretical world discussed within the lecture hall and "the real" world outside it. In economics (and presumably other sciences as well), theoretical models can sometimes be highly abstract representations of the subject studied. For instance, in international trade theory a typical model of the world contains two countries (e.g. EU and China), in which two types of agents (e.g. workers and capitalists) produce two products (e.g. clothes and automobiles). The model then goes on to show what happens when, under different circumstances, the EU and China engage in trade with each other. When I posed this question in the final exam, many students did not answer in terms of the model as expected. Instead they wrote a small essay discussing the general trade relationship between the EU and China, based on information obtained from the news or their general "common sense".

To me, this experience demonstrated the danger of teaching declarative knowledge for "knowledge's sake". When designing a course with the stated purpose that students should gain knowledge of and understand a list of theoretical models, we ignore the important question of "why"? Why should the students bother trying to understand these abstract and often complicated models? Because the teacher says so? And what is worse, we tend to design our teaching activities (read: lectures) based on this line of

reasoning: we prepare lectures to "cover" a given range of material (Gibbs; 1981).

Of course, as trained economists, we know that the theories are not (or very seldom) the end themselves, but merely means to an end. The real (implicit) purpose of the course is to allow students to *use* the theories in order to make sense of the real world, to explain why we observe certain developments, to predict what is likely to happen in the future and to recommend policies to address problems. All this requires that we are able to bridge the gap between "the real world" and "the theoretical world", first in one direction by "translating" what we observe in the real world into something the theory can process, and then in the opposite direction by "interpreting" the results of our analysis in terms that the real world can understand. I call this to think as an economist, and to a trained economist it comes as a second nature. It is something we have learned to do along the way during our own studies. But to a first year student, it is not so obvious. To learn to think as an economist is exactly the implicit purpose of the course (indeed, the entire economics programme), so why not make it explicit?

Redesigning the course

I decided to stop thinking about international economic theory as declarative knowledge and to start thinking in terms of functional knowledge and seek inspiration in some of the techniques relevant to functional knowledge learning, such as Problem-Based Learning (van der Vleuten et al.; 1996) and its smaller sister, Case-Based Learning. I imagined the students as professionals, e.g. officials in the Ministry of Foreign Affairs, whose job it is to advise the Foreign Minister on topics of international trade policy and exchange rate policies.[1] This picture formed the basis of a redesign of the course implemented this spring.

I sought to design all elements of the course, from Intended Learning Outcomes (ILOs), to assessment techniques and TLAs, according to the functional knowledge way of thinking. First, I specified new ILOs to reflect this, notably the following ILOs:

- *apply* relevant economic theories to real world issues. This involves i) setting up an economic model applicable to the real world issue; ii) conducting relevant analyses (comparative statics) within the model; and

[1] Technically, these issues are determined at the EU level and not in Copenhagen, but I suppose the Foreign Minister still needs to be advised on the issues.

iii) interpreting the results in terms of real world concepts and providing policy conclusions/recommendations

- *evaluate* the applicability of different economic models for analysing specific real world issues

All course activities followed this pattern. A student assignment would present a desription of a real world case and ask a few questions framed in real world terms. The students' task would then be to first translate the case and questions into a format resembling the theories taught in class, then to answer the questions using the theretical models, and finally to interpret the results, i.e. to translate back again from the theoretical terms into a language understandable by non-economists. Afterwards, the students were asked to evaluate the models by asking such questions as; which issues are "lost in translation"? Is there something in the real world case that the models are not equiped to handle? How important are these lost issues?

I prepared a syllabus detailing the topics (and corresponding chapters in the textbook) to be discussed at "lectures"[2]. Before each "lecture" I made available a newspaper article (typically obtained from the archives of The Economist, Financial Times or The New York Times) discussing an issue relevant for that "lecture" together with a number of study questions related to the article.

An ideal "lecture" would go like this: Before the "lecture" the students would read the study questions and keep them in the back of their minds (or on a piece of paper in front of them) while studying first the newspaper article and then the relevant chapter in the textbook. The idea was that the newspaper article should provide a real world context and the study questions a purpose for the students' study of the textbook. I did not expect the students to answer the study questions before coming to class, but they would ideally initiate the students' thinking about them. The time at the "lectures" would be spend going through each of the four steps detailed above (translation, analysis, interpretation and evaluation), first by the students themselves in small groups and then as a general class discussion.

A key element of this approach is that student-teacher contact time is used to help the students *use* the theory to understand real world issues instead of teaching the material in the textbook directly. At the beginning of (and repeatedly during) the course I made it clear to the students that I did not intend to lecture on the material found in the textbook. I operated

[2] I use the term "lecture" to denote the time slot available for student-teacher contact, not the activity taking place during that time slot.

under the assumption that the students had all prepared for the lecture, and had studied and understood the relevant chapters in the textbook. This has proven to be advantagous in several ways. The students feel that the "lectures" are not a complete waste of time as I am not just repeating what they can read by themselves in the textbook. They are more motivated for spending time on their own studying, as they have discovered (the hard way) that they cannot simply skip the textbook and pick up the main ideas at the lectures. From the teacher's point of view, it has also turned out to be somewhat of a relief as the pressure to fit a wide range of material into what little contact time is available has abated.

I designed the student assessment along the same lines in order to achieve better alignment with ILOs and TLAs. All the test problems presented to the students for assessment had the exact same structure as the in-class TLAs described above. In fact, in the first "lecture" (and repeatedly thereafter) I described to the students what the exam would look like and told them that all we would ever do in the course is to train for the exam. Evidence suggests that students are very mindful of the expected requirements at assessment and tend to structure their learning according to these expectations (referred to as "Backwash", Biggs & Tang (2007)). I decided I may as well use this to achieve as much alignment as possible.

Evaluation

I have three sources of information, upon which to base my evaluation of the redesign introduced this spring: grades, students' course evaluation and my own personal impressions (self evaluation), all comparing the redesigned course with last year. None of them are particularly objective in nature, and there is a risk that over-enthusiasm on my part may colour my evaluation. With that in mind, I will try to provide as balanced a picture as possible.

Grades

Student grades in 2009 (first year teaching) and 2010 (the redesigned course) are shown in figure 10.1. It shows little movement in the lower end of the scale (although a few more students failed in 2009 than in 2010) but considerable upgrading from the middle ground to the higher grades.

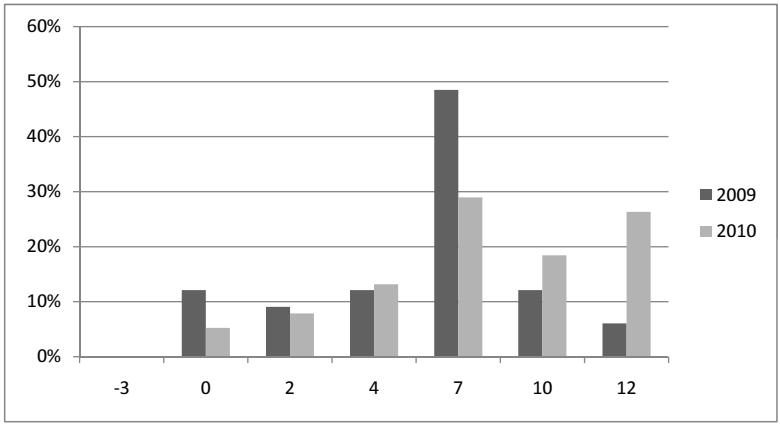

Fig. 10.1. Frequency of student grades in 2009 and 2010

This suggests that the redesign of the course has had a positive effect on many students' performance, particularly around the average range.

It is interesting to see that rougly the same share of students' performance were assessed to be in the below-average range in 2010 as the year before. I take this as an indication that not all students benefit equally from the changes in activities and assessment techniques. There can be various reasons for that. For instance, the small group work taking place at the "lectures" were organised on a voluntary basis, and I allowed the students to work individually if they wanted to (most chose to work in small groups). The risk is that the students who were most challenged by the material, were also the ones opting out of the group work and that they therefore benefited little from the activities. Another reason could be that some students chose to study the material by themselves and did not attend many of the "lectures". Whether they are the ones obtaining the lowest grade I do not know. Whatever the reason, it is worth noting the pattern and considering for next year whether the TLAs are designed sufficiently flexible to allow all students to benefit from them.

Students' course evaluation

I did not design a student survey specifically adressing the new design of the course. Instead, as I had taught the same course last year using more

traditional lecturing techniques, I wanted to utilise this opportunity to compare the students' perceptions of the two approaches. The students' course evaluations provided a standardised way of investigating these experiences.

I will not go into exhaustive detail with the evaluation. Instead, I will comment of three of the questions I find particularly informative in this respect and discuss a few of the students' elaborations. The students were asked to state whether they agreed or disagreed with the following statements:

1. All in all the course was good
2. The course provided room for my active participation
3. The teacher stimulated me to reflect on academic issues related to the course

Looking at the answers, it turns out that the three statements solicited pretty much the same response. To keep this exposition brief, I present the students' answers to the first question in figure 10.2 and leave out the other two.

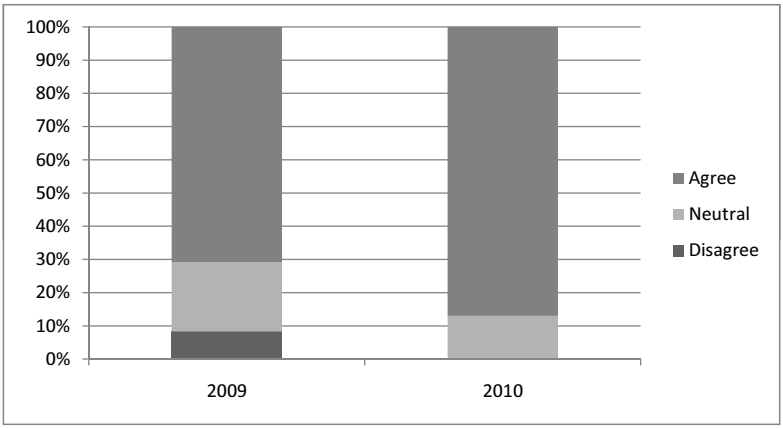

Fig. 10.2. Students' response to the statement: "The course was good"

There seems to have been an improvement in the students perception of the course in general, and in their opportunities for active participation and reflection within the course, although their opinion of the course was not too bad to begin with. Looking at some of the specific comments to

the 2010 evaluation paints more or less the same picture. Most are positive along the lines of "Great balance between theory and practise...", and "The articles were great – it was possible to apply what you had learned studying the textbook and during class", and many specifically noted that they had no suggestions for further improvements and "I wish all courses were like this...".

There were, however, also students who preferred the traditional way of lecturing or who felt that I had gone too far in focusing on student activities. One student wrote "Sometimes too much time was spent talking in groups. It is good that students are more involved in the lectures, but sometimes time could be saved by going through the material on the blackboard..." and several students suggested that we spend less time on group work and more on traditional lecturing.

It is difficult to judge to what extent these comments are representative of most students. The overall impression of the course evaluation is one of a very positive student perception of the course in general and student activities in particular. On the other hand, the comments suggesting that the scales have shifted a bit too far in the direction of student group work appear to be more than the voices of just one or two disgruntled students. It is worth considering if a slightly more balanced approach is optimal.

Self evaluation

My own personal impression of the outcome of the redesign of the course pretty much mimics the picture painted by the grades and the student evaluations. I have decided here to list a few of the small signs of improvements that convinces me that the approach described in this project is a better approach to teaching than the traditional lecturing format:

- Students are more awake: I am now able to keep the students' attention for a longer period of time, simply because the "lecture" is broken into smaller units, each no longer than 20 minutes, alternating between group work, discussion and actual lecturing.
- More students are actively engaged in the discussions: Last year, when I attempted to raise discussions in class, a relatively small number of the most motivated students responded. This year, discussion were still limited to only a part of the class, but the share was considerably larger than last year.
- Students are more well-prepared for class: There was to me a clearly noticeable improvement in the extent to which the students prepared

for class during this year's course. At the beginning of the course, most students had a difficult time working out the problems posed. However, after a few weeks, during which I had demonstrated to them that I meant it seriously when I told them that I would not lecture on material described in the textbook, the students performance improved significantly.

- Many students mastered difficult concepts: I noticed in home assignments and the final exam that many of the students demonstrated understanding of concepts that are considered difficult parts of the field. As an example, I asked the students in the final exam to explain the concept of *Comparative Advantage*, a core concept in international trade theory, but one that many non-economists fail to appreciate. I was happy to note that although several students failed to answer this question correctly, many did, and almost all were on the right track.

Perhaps the best indication of the improvement in the students' performance is that virtually none of them displayed the difficulties in distinguishing between real world and theory observed last year. All students attempted to "think as economists", albeit with varied success.

Conclusion

My experience from the last two years of teaching in International Economics has demonstrated to me that considerable improvement in students' learning can be achieved by rethinking declarative knowledge learning more along the lines of functional knowledge learning. In many conversations with colleagues, I have come across the perception that many of the courses we teach have little to do with the real world – the students must understand the basics of abstract theoretical economics before they can be expected to apply the theories to real world problems. I would tend to disagree. We cannot expect students to be highly motivated for learning abstract theory by telling them that the purpose of the course is to learn theory for the sake of theory (I suppose some students are motivated by this, but they are probably a minority), or by promising them that one day they will discover its relevance. However, by asking the students to solve real world problems that they can relate to, we force them to learn the theories by themselves in order to solve the problems. My experience in this regard has been favourable. But there is still room for improvement next year.

11

Revision af laboratorieøvelse for større engagement og udbytte

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Introduktion

Kurset "Molekylær genetik / Genetik" består af forelæsninger, teoretiske øvelser og (for Molekylær genetik – delen) laboratorieøvelser inkl. rapportskrivning. Molekylær genetik-holdet består af ca. 60 studerende – heraf de fleste bioteknologistuderende på bachelorniveau. Jeg har undervist på kurset i en enkelt laboratorieøvelse sidste år (sekventeringsøvelsen), og skulle have samme øvelse igen i år. For at inkludere mest muligt pensum i én og samme øvelse, skulle de sidste år sekventere på klonede PCR-produkter og dermed forholde sig til både kloning og sekventering. Denne øvelse ligger før de forelæsninger, hvor sekventerings- og kloningsteknikken bliver gennemgået, så teorien er ny for de studerende. Formålet med denne øvelse er, at de studerende skal prøve sekventeringsteknikken og selvfølgelig beskæftige sig med teorien bag og anvendelsen af denne teknik. I tråd med traditionen på kurset var øvelsen delt op i 1) en kort teoretisk introduktion 2) selve laboratoriearbejdet og 3) resultatanalyse og rapportskrivning, som inkluderede nogle opgaver til øvelsen. Min erfaring fra sidste år er, at de studerende mødte mere eller mindre uforberedte op til den teoretiske introduktion med et print af øvelsesvejledningen under armen. De arbejdede koncentreret i laboratoriet, men med fokus på at håndtere udstyr og materialer rigtigt og få genereret et resultat til deres rapport. Først til resultatanalyse og rapportskrivningen blev de studerende tvunget til at forholde sig til teorien og hvad de egentlig havde foretaget sig i laboratoriet. Det var her tydeligt at de fleste ikke havde forstået formålet med øvelsen, teorien bag de emner, øvelsen adresserede og hvad der foregik i de enkelte trin. Li-

geledes var der generelt en ringe forståelse for det eksperimentelle design. Alt dette fremgik tydeligt af deres rapporter, som afslørede et middelmådigt udbytte af øvelsen.

Analyse af problemet og teoretisk baggrund

Samlet set kan man sige, at øvelsesforløbet sidste år var præget af overfladiske læringsstrategier og et relativt lavt udbytte. Det kan der være flere grunde til. For at få identificeret oplagte indsatsområder er det nødvendigt at kigge på de enkelte elementer i øvelsen og reflektere over de TLA'er (Teaching/Learning Activities) der var i brug.

Mange studerende mødte uforberedte op til øvelsen og manglede det teoretiske grundlag til resultatanalysen og rapportskrivningen. Eksisterende viden er det fundament, den nye viden skal bygges på og som enhver undervisningssituation bør tage udgangspunkt i. Desuden er det værdifuldt at have noget at referere til i undervisningen – både som studerende og underviser. Det at møde forberedt op til en undervisningssituation, giver også de studerendes motivation et skub i den rigtige retning, ikke mindst når de får bekræftet brugbarheden af den viden de allerede besidder (Biggs & Tang; 2007). Så især når den teori, der skal adresseres i øvelsen, er nyt stof, er en vis grad af forberedelse meget relevant.

Øvelsen var ikke problembaseret sidste år, og var egentlig blot en række teknikker og procedurer, som de studerende fik lejlighed til at prøve. Dermed bliver den nye viden de skal tilegne sig en række urelaterede detaljer, som jo egentlig har en struktur når de ses i sammenhæng med et problem. Når undervisningen er problembaseret, skal de studerende strukturere deres viden således at den kan anvendes til at løse en problemstilling. Desuden sættes de studerende i en situation, der kræver deres umiddelbare engagement for løsning af opgaven, og er niveauet passende, er dette i sig selv motiverende (Biggs & Tang; 2007).

Øvelsens faglige niveau var nok lidt for højt sidste år. Her skulle de sekventere på klonede PCR-produkter, og dermed forholde sig ikke bare til sekventering men også til kloning. Især under resultatanalyse/opgavedelen blev det tydeligt, at denne øvelse introducerede mere ny teori end de studerende kunne overskue. Det er vigtigt for de studerendes motivation, at de føler, de har en rimelig chance for at "komme i mål". Afstemning af det faglige niveau er derfor vigtig (Biggs & Tang; 2007). Af rapporterne frem-

gik det tydeligt, at den faglige "bredde" i øvelsen gik ud over forståelsen af både kloning og sekventering – at vi havde "sat os mellem 2 stole".

De studerende arbejdede effektivt i laboratoriet, men tilsyneladende uden forståelse for det eksperimentelle design og hvad der foregik i hvert enkelt trin. Men som studerende og nybegynder i laboratoriet kan det være stressende og uoverskueligt på samme tid at skulle forholde sig til håndtering af udstyr, have overblik over øvelsens teoretiske formål og at samle data sammen. Nye materialer og udstyr kan også let stjæle de studerendes opmærksomhed fra de vigtige videnskabelige koncepter, som burde have været i fokus. Resultatet bliver derfor ofte "kogebogsarbejde" uden forståelse for sammenhængen mellem formålet med undersøgelsen og eksperimentets design (Lunetta et al. (2007); Wood (1996)). Den teoretiske introduktion sidste år var meget kort, med fokus på den teoretiske baggrund og uden studenteraktiviteter. Lunetta et al. (2007) understreger fordelen ved at adskille øvelsens forskellige discipliner i separate afdelinger således, at de studerende arbejder med og opnår en forståelse for øvelsens formål og teori i en pre-lab session og får koblet og anvendt deres resultater i en post-lab rapportskrivning og diskussion.

Det eksperimentelle design eller metoden, var af praktiske grunde fastlagt (lukket) forud for øvelsen. Metoden var altså heller ikke noget de forholdt sig aktivt til, og deres forståelse for den var tilmed begrænset. Udbyttet af en laboratorieøvelse kan til dels afhænge af graden af åbenhed i de forskellige dele af øvelsen. Ved at lade f.eks. metodedelen i øvelsen stå åben – altså lade de studerende selv forholde sig til valg af metode til at løse et givent problem – kan man styrke deres forståelse og udbytte på dette felt (Tamir; 1989).

Mål

Formålet med dette projekt var – med udgangspunkt i sidste års erfaringer – at revidere en laboratorieøvelse for at styrke de studeres udbytte. Jeg ville primært undersøge hvordan en høj vægtning af det teoretiske forarbejde incl. forberedelse påvirkede de studerendes overblik, motivation og intellektuelle engagement i alle dele af øvelsen, dvs. både forarbejdet, laboratoriedelen og resultatanalysen. For at forbedre de studerendes forståelse for metoden, ville jeg desuden gerne "åbne" øvelsen ved – på et teoretisk plan – at lade de studerende tage stilling til det eksperimentelle design.

Desuden ville jeg justere øvelsens faglige niveau med det formål at sikre en forståelsesmæssig dybde af en mindre del af pensum. Samtidig skulle øvelsen i år være problembaseret for både at gavne udbytte og motivation.

Ved at sammenligne egne observationer under øvelsen med sidste års observationer og ved gennemgang af rapporterne samt evalueringerne ville jeg vurdere, om ændringerne havde en gunstig effekt på de studerendes udbytte, motivation og engagement sammenlignet med øvelsen sidste år.

Metode og TLA'er

Med de planlagte ændringer, kom øvelsen til at forløbe således:

1. Forberedelse til øvelsen (individuelt)
2. Teoretisk forarbejde (i plenum/grupper mandag 9-10.30)
3. Laboratoriearbejde (i grupper, resten af mandag + onsdag formiddag)
4. Resultatanalyse/opgaver (i grupper, onsdag 13-17)
5. Evaluering

ad 1) Jeg havde besluttet at de studerende i år skulle lave PCR på cDNA og sekventere deres eget PCR-produkt for dermed at undgå kloningsdelen. I stedet skulle de så forholde sig til PCR og cDNA, hvilket jeg vurderer som mindre kompliceret end kloning.
For at de studerende skulle være bedst muligt rustet til at arbejde teoretisk med opgaven og for at signalere en forventning til deres engagement, havde jeg ugen forinden sendt en liste over "anbefalet læsestof" (ca. 10 sider i deres lærebog). Som tidligere nævnt er det, at møde op med en portion basal viden et optimalt udgangspunkt for at anvende dybe læringsstrategier og et vigtigt fundament for opbygning af ny viden (Biggs & Tang; 2007). Samtidig fik de et oplæg til øvelsen bestående af en problembeskrivelse, som dækkede en lille, velafgrænset del af mit eget forskningsprojekt (appendiks A). I modsætning til sidste år, havde jeg i år valgt en problembaseret øvelsesform med det formål at skabe bedre sammenhæng mellem de forskellige dele af øvelsen, at sikre de studerende en mere konceptuel arbejdsform samt en mere struktureret brug af deres viden. Samtidig forventede jeg også, at denne øvelsesform ville styrke motivationen (Biggs & Tang; 2007). Øvelsens læringsmål (appendiks A) blev også lagt ud på intranettet.

ad 2) For at lægge større vægt på teorien bag øvelsen, koblingen mellem teorien og deres arbejde i laboratoriet og for samtidig at engagere dem i

metoden, havde jeg sat $1\frac{1}{2}$ time af til det teoretiske forarbejde mandag morgen. Her var jeg alene om undervisningen. Jeg tog et kort udgangspunkt i casen og satte de studerende i gang med gruppearbejde. De skulle her snakke om, hvordan man kunne gribe sådan en opgave an i laboratoriet. De fik desuden nogle hjælpespørgsmål, som skulle lede dem i den rigtige retning og hjælpe med at dele opgaven op i overskuelige bidder (appendiks A). Sådan en opgave kan naturligvis løses på flere måder. Men af pædagogiske årsager og af hensyn til tiden syntes jeg, det var hensigtsmæssigt at (via hjælpespørgsmålene) spore dem i retning af den metode, som jeg havde forberedt materialer og instrumenter til i laboratoriet. Ud over det faglige udbytte af arbejdet med metoden, sigtede jeg også efter at styrke deres følelse af ejerskab samt motivation i forhold til øvelsen. Desuden havde jeg en forventning om at et bedre fagligt overblik over øvelsen inden laboratoriedelen ville "frigøre" kapacitet til at tænke over teorien i hvert enkelt trin under laboratoriedelen.

Undervisningsformen var i denne del problembaseret med gruppearbejde og opsamling på tavlen. Det var mit mål, at de studerende skulle finde frem til nogle overordnede trin i metoden, og at det var deres bud på opgaven, der skulle på tavlen. Vi lavede opsamling på tavlen efter de første 2 spørgsmål og igen efter de sidste 4. Derefter gik jeg – i dialog med de studerende – i dybden med hvert enkelt trin med fokus på materialer og metode og kobling til teorien. Tavleproduktet blev hermed et flowdiagram over øvelsens trin samt uddybende punkter og tegninger til de enkelte trin.

ad 3) Inden selve laboratoriedelen, fik de studerende udleveret en protokol, som egentlig blot var en lidt mere detaljeret udgave af tavleproduktet fra del 2. I denne del af øvelsen var der 2 laboranter ud over mig selv til at hjælpe de studerende i laboratoriet. Jeg havde lagt vægt på, at de studerende ikke skulle være tidspressede i laboratoriet samt, at de ikke skulle konfronteres med for mange nye redskaber og udstyr. Alle hold skulle som sidste punkt onsdag formiddag have deres prøve i sekventeringsmaskinen, som befinder sig i et lille laboratorium i den anden ende af campus. Der var derfor ikke mulighed for at de selv kunne se maskinen og sætte deres prøve i. Maskinen udfører det centrale i øvelsen, og kan ikke erstattes af andet udstyr. Samtidig er den ikke særlig "visuel" forstået på den måde, at den "bare" spytter sekvenserne ud på en computer efter endt kørsel. Sådan en maskine kan komme til at vir-

ke som en ”black box” der hindrer de studerendes forståelse af det, der egentlig foregår i maskinen (Lunetta et al.; 2007).

ad 4) For at understrege læringsmålene, blev de gennemgået onsdag eftermiddag. Herefter skulle de studerende arbejde med deres resultater vha. en række opgaver. Her var vi igen de samme 3 til at hjælpe de studerende. De 2 laboranter er rutinerede i sekvensanalyse og de havde sat sig grundigt ind i opgaverne. Målet med opgaverne var, at få de studerende til igen at beskæftige sig med teorien bag øvelsen, at få dem igennem en analyse af egne resultater og anvende deres resultat til at ”løse” problemet. Derudover skulle de studerende komme med et bud på hvordan deres resultat kunne anvendes i en større forskningsmæssig sammenhæng, som problemformuleringen også havde lagt op til. Formålet med netop disse opgaver var, at de studerende ud over at få opfyldt læringsmålene, skulle kunne se den praktiske anvendelighed af øvelsens disciplin i forskningsmæssig sammenhæng. Hermed bliver øvelsens læringsmål sat i en ramme, som på autentisk vis illustrere brugbarheden. Dette kan have stor betydning for motivationen og engagementet og dermed også for udbyttet.

ad 5) Til slut evaluerede de studerende øvelsen vha. et evalueringsskema, som primært drejede sig om forberedelse, sværhedsgraden, udbytte, engagement og motivation (se appendiks B. De fleste mødte op til resultatanalysen/opgavedelen og heraf var der 34 studerende, der evaluerede øvelsen. Nogle besvarede ikke alle spørgsmål. Desuden er kommentarer fra den obligatoriske kursusevaluering inddraget i denne opgave til belysning af de studerendes oplevelse af øvelsen.

Resultater og diskussion

1.+2. De studerende var generelt tilbageholdende med at deltage i dialogen omkring hvordan opgaven kunne gribes an i laboratoriet. Så dialogen foregik mellem mig og de samme 3-4 studerende. Da vi havde fået de overordnede trin på plads og gik i dybden med hver enkelt trin kom der lidt mere gang i dialogen. Stort set alle havde læst noget af eller alt det anbefalede læsestof, som de generelt vurderede som en hjælp til arbejdet (appendiks B). De vurderede også opgavens sværhedsgrad som passende og hjælpespørgsmålene som en god hjælp til at dele opgaven op i små bidder (appendiks B). Uden evalueringerne, ville jeg have opfattet den sparsomme feedback fra de studerende som tegn på,

at de ikke havde læst og/eller, at niveauet var for højt. Men man må konkludere, at de bare ikke havde mod på at stå frem i forsamlingen og sige noget mens alle lyttede. Her er det vigtigt at huske, at dialogbaseret undervisning kræver tilvænning for de studerende og det at skulle forholde sig til det eksperimentelle design var helt uvant for dem. Men samtidig må man som underviser ikke glemme, at selvom dialogen er lidt tung er det ikke ensbetydende med at de studerende ikke tænker – hvilket jo er det egentlige formål.

De studerende syntes, de havde et godt overblik over øvelsen efter den teoretiske start. Sammenlignet med kursets andre øvelser (dette svarer til at sammenligne med samme øvelse, som den var tilrettelagt sidste år) havde de en bedre forståelse af teorien. Dette blev også kommenteret i den obligatoriske kursusevaluering:

"Rigtig godt med en grundig gennemgang af tingene inden øvelserne, nu når teorien ikke kom før til forelæsningerne."

"Selv gennemgang af basale ting var godt, idet det var godt at få det sat i forbindelse med lige netop det forsøg vi lavede."

Intentionen med det teoretiske forarbejde var også at "åbne" denne del af øvelsen og få de studerende til at tænke over det eksperimentelle design. Det at give de studerende hjælpespørgsmål i det teoretiske forarbejdet med øvelsen kan give anledning til, at de studerende forsøger at finde ud af hvilken måde underviseren mener, de skal tænke på i stedet for at bruge den viden, de har og deres kreativitet. Men der var flere hensyn at tage. Dels havde de ikke fået gennemgået stoffet til forelæsning. Derfor mente jeg, at en smule hjælp var nødvendig for at tilpasse niveauet og sikre en vis følelse af succes. Vi havde heller ikke havde ubegrænset tid til rådighed og desuden skulle materialer og instrumenter være klar i laboratoriet. Selvom man som underviser har tænkt og planlagt en bestemt metode, som dermed fordrer lukket tænkning ("convergent"), kan processen jo godt være åben ("divergent"), da alle teoretiske bud på løsningen af opgaven starter en faglig diskussion og sætter tanker i gang. Dette var overvejende tilfældet i den del, hvor vi gik i dybden med de enkelte trin. Her bidrog de studerendes bud således til at få diskuteret nogle muligheder og afklaret nogle misforståelser. Disse ting var muligvis ikke blevet bragt på banen under en sædvanlig øvelsesintroduktion, som den forgik sidste år. Så til trods for en vis styring via hjælpespørgsmål og opsamlinger, var denne del af øvelsen i sammenligning med sidste år mere åben og med større vægtning af studenteraktiviteter.

3. De studerende tænkte en del eller ind imellem over teorien i hvert enkelt trin, mens de arbejdede i laboratoriet (appendiks B). Mit indtryk fra laboratoriet var at de studerende havde styr på hvor i øvelsen de var, og at opmærksomheden var ligeligt fordelt mellem det praktiske/håndteringen og det teoretiske. Dette vurderer jeg som en optimal balance – især fordi de i forvejen havde arbejdet grundigt med det teoretiske. Dette indtryk kan understøttes af nogle kommentarer fra den obligatoriske kursusevaluering:
   "…gik så grundigt igennem stoffet inden lab øvelsen – det gjorde at man bare havde tjek på hvad man lavede i lab øvelsen…"
   "…på grund af den gode struktur og dine gode briefinger inden lab, så vi tænkte over hvilke ting vi arbejdede med, når vi så kom op i lab…"
   "…grundig gennemgang af hvad der skulle foregå i laboratoriet, så man ikke gik og famlede i blinde…"
   Det er altså min klare fornemmelse, at dette er en forbedring i forhold til sidste år.
   Det at de studerende ikke selv så og anvendte sekvensmaskinen, gik i varierende grad ud over forståelsen for halvdelen af de studerende. For de øvrige var det uden betydning (appendiks B). Dette bekræfter til dels, at det kan være problematisk med apparatur, som udgør en "black box" og understreger nødvendigheden af undervisningsaktiviteter, der kan kompensere i forhold til de studerendes forståelse.
4. + 5. Efter egen vurdering var resultatanalyse/opgavedelen et godt redskab til at få anvendt teorien, deres egne resultater og erfaringer fra laboratoriet simultant. Casen byggede som forventet bro mellem øvelsens 3 dele og var samtidig befordrende for de studerendes engagement og motivation. De studerende giver således også udtryk for, at der har været god kobling mellem teori og praksis, at deres motivation har været stor/mellem og at det har været vigtigt for deres motivation, at øvelsen var problembaseret (appendiks B).
   De studerende havde i høj grad eller til dels lært det, der stod i læringsmålene, som spændte over flere niveauer i SOLO taxonomien (Biggs & Tang; 2007) (appendiks B). For at kunne differentiere mellem de enkelte læringsmål hos dem, der svarede "til dels", skulle de tage stilling til hvert enkelt læringsmål. Det var overvejende "planlægge og udføre PCR og sekventering" som en lille gruppe studerende ikke følte sig sikre i. Selvom læringsmålene generelt blev indfriet, er denne evaluering god at skele til inden næste års øvelse.

Sammenlignet med øvelsen sidste år, var de studerende langt bedre klædt på til den sidste del af øvelsen. De havde bedre overblik over den grundlæggende teori og kom derfor lettere gennem analysen samt opgaverne.
Den hjælp, de havde brug for undervejs, drejede sig overvejende om softwaren til sekvensanalysen og det spørgsmål, der drejede sig om anvendelse af resultatet i større forskningsmæssig sammenhæng. Det fik vi så nogle gode diskussioner ud af. Det at skifte kloning ud med cDNA og PCR har sikkert også bidraget til en højere succesrate hos de studerende. Et argument imod denne prioritering kunne være, at kloning dermed ikke bliver "dækket" af en laboratorieøvelse. Men hvis målet er fagligt udbytte, engagement og motivation, er det hensigtsmæssigt at satse på dybde i stedet for bredde.
Rapporterne havde generelt højere standard i år end sidste år. Teorien bag sekventering volder kvaler på alle genetikkurser, men langt de fleste grupper leverede en overbevisende gennemgang heraf. Større eller mindre dele af tavleproduktet fra mandag morgen (tegninger/flowdiagram) gik igen i mange rapporter, hvilket bekræfter at de har haft et godt forståelsesmæssigt udbytte af denne del af øvelsen. Dette kommenteres også i den obligatoriske kursusevaluering:
"Strukturen var rigtig god, så jeg vidste hele tiden hvor i øvelsen jeg var, og det gjorde det også meget lettere at skrive en overskueligt rapport"

Konklusion og perspektivering

At dømme ud fra både min egen oplevelse af øvelsens forløb, evalueringerne og rapporterne, har de relativt få og enkle omprioriteringer jeg har gjort i forhold til sidste år haft en god effekt.

Den primære ændring har været en højere vægtning af det teoretiske forarbejde: De studerende har fået en opfordring til forberedelse hjemme, $1\frac{1}{2}$ time blev sat af til denne del af øvelsen mod 20 minutter sidste år, metodedelen var "åben" og dermed genstand for studenteraktiviteter i form af gruppearbejde og dialog omkring det eksperimentelle design og øvelsens forskellige trin. Til trods for en lidt tung dialog skabte denne del af øvelsen et godt overblik over teorien og sammenhængen med laboratoriearbejdet. I laboratoriet var der ikke kun fokus på håndtering af materialer

og instrumenter men også på teorien i det, de arbejdede med. De studerende var godt rustet til arbejdet med resultatanalysen og opgaverne, hvilket også fremgik af rapporterne, som afslørede et højere fagligt niveau i forhold til sidste år. Fordelen ved en problembaseret øvelse blev især tydelig under resultatanalysen, hvor de studerende både anvendte deres teoretiske viden og egne resultater til at "løse problemet". Kloningsaspektet, som er relativt komplekst, blev i år skiftet ud med cDNA og PCR. Denne disponering har kostet en smule faglig bredde men sandsynligvis bidraget til de studerendes forståelsesmæssige dybde. Alt i alt har ændringerne styrket de studerendes engagement og udbytte af sekventeringsøvelsen.

Der bruges generelt mange ressourcer på en laboratorieøvelse, og skal de studerendes udbytte af øvelsen stå mål med disse ressourcer, er det vigtigt, at man som underviser tager udgangspunkt i de studerendes forudsætninger og behov når undervisningen tilrettelægges. Omstrukturering af en øvelse koster tid, men da mange af principperne for de studerendes læring i øvelsessammenhæng er universelle, kan en del af strukturen genanvendes på tværs af øvelser og kurser. Fokus på det teoretiske forarbejde med studenteraktivering, adskillelse af øvelsens discipliner og dybde på bekostning af bredde har således haft en positiv indflydelse på de studerendes engagement og udbytte af denne øvelse, men er samtidig universelle tiltag, der med fordel kan – og bør – ekstrapoleres til andre laboratorieøvelser.

A Oplæg til teoretisk forarbejde + læringsmål

Relevant læsestof (EG, 5.ed.)

S. 213-16 (PCR + sekventering)
S. (266-)268-73 (transkription, RNA, mRNA, genstruktur (exon/intron), fig. 8.16!)
S. 337-39 (cDNA. Prøv at se bort fra kloningen i dette afsnit. cDNA kan bruges til meget andet!)

Introduktion til case

I en besætning af grise har man observeret en afvigende fænotype, der bl.a. er karakteriseret ved lungeemfysem (progressiv nedbrydning af lungevævet). Fænotypen har en autosomal, codominant arvegang. Fra musestudier

ved man, at fejl i genet ITGB6 (koder for Integrin ß6, som er en del af en receptor) kan medføre lungeemfysem. ITGB6 er derfor et oplagt kandidatgen for et mutationsstudie hos grisene. Den fulde genomiske ITGB6 sekvens er mange kb lang, men den kodende sekvens (Open Reading Frame, ORF) er kun ca. 2.5 kb fordelt på 15 exons. Denne øvelse går ud på at sekventere ("læse rækkefølgen af baser") en del af den kodende sekvens af genet ITGB6 hos en syg gris og derefter sammenligne med sekvensen fra en rask (denne "raske" sekvens er tilgængelig og bliver "udleveret" d. 12.). Den sidste del (exon 11-15) koder for nogle vigtige sites i proteinet/receptoren, og det er derfor denne del af sekvensen der skal sekventeres.

Oplæg til teoretisk arbejde med dagens øvelse

Diskutér i grupper hvordan man kan gribe opgaven an. Brug gerne bogen. Hvilke overordnede trin skal man igennem i laboratoriet?

Hjælpespørgsmål: Hvad er forskellen på den fulde genomiske sekvens og den kodende sekvens? I hvilken type molekyler i cellen har vi udelukkende den kodende sekvens repræsenteret? Brug 10 minutter på de første 2 spørgsmål – herefter samler vi op på tavlen i fællesskab . Disse molekyler er svære at håndtere i laboratoriet – hvorfor? Kan vi gøre dem "håndterbare"? Forud for sekventering skal man lave en opformering/amplifikation af den sekvens man skal sekventere. Hvorfor? Hvilken metode til amplifikation vil I vælge? Opsamling på tavlen igen.

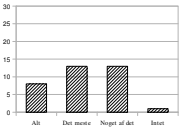
Læringsmål til sekventeringsøvelsen

- Forstå teorien bag PCR og sekventering
- Planlægge og udføre en PCR-reaktion og en sekventeringsreaktion
- Beskrive opbygningen af (og forskellen på) en fuld genomisk sekvens, primært RNA, mRNA og cDNA
- Udføre og fortolke alignment af sekvenser

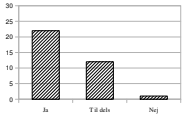
B Evaluering

Appendiks B: Evaluering

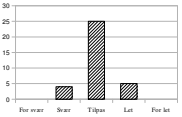
1. Fik du læst det anbefalede læsestof?



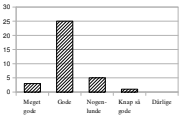
2. Gav læsningen en viden, som du kunne bruge til den teoretiske start på øvelsen?



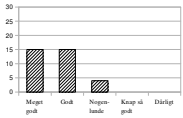
3. Hvordan vurderer du sværhedsgraden i den teoretiske diskussionsopgave mandag morgen?



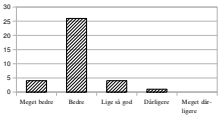
4. Hvor gode var hjælpespørgsmålene som hjælp til at dele opgaven op i overskuelige bidder?



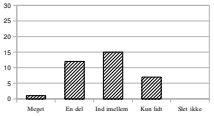
5. Hvor godt var dit overblik over øvelsen efter den teoretiske start mandag morgen?



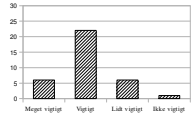
6. Sammenlignet med kursets andre laboratorie-øvelser,hvor god var din forståelse af teorien efter den teoretiske start mandag morgen?



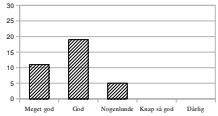
7. I hvor høj grad tænkte du over teorien i hvert enkelt trin ("hvad der foregår nede i røret") mens du arbejdede i laboratoriet?



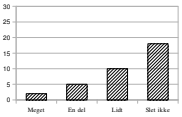
8. Hvor vigtigt er det for din motivation, at øvelsen tager udgangspunkt i en case, hvor du skal "undersøge noget"?



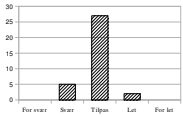
9. Hvor god har koblingen mellem teori og praksis været i denne øvelse?



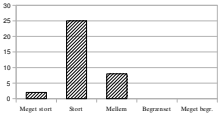
10. Går det ud over din forståelse, at du ikke selv får set og brugt sekvenatoren?



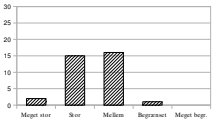
11. Hvordan vurderer du sværhedsgraden i sekvensanalysedelen (onsdag eftermiddag)?



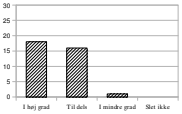
12. Hvordan vurderer du dit samlede udbytte af øvelsen?



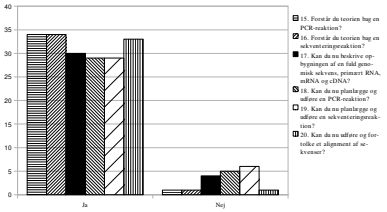
13. Hvor stor har din motivation været i denne øvelse (samlet set)?



14. Har du lært det, der står i læringsmålene?



Læringsmålene



12

Problem Based Learning and the university field course in zoology: the way to success

Alexey Solodovnikov

Zoological Museum, SCIENCE, University of Copenhagen

Introduction

"Terrestrial Zoology" is a mandatory field course within the "Feltbiologi II" block offered for the first year biology students at the University of Copenhagen. Two years of experience with this course revealed a number of didactic problems negatively affecting educational quality of the course. As a result of the inventory and analysis of those difficulties, a new format of the course is proposed, that is largely based on the principles of the Problem Based learning and Constructive Alignment. Unlike previous format of the course, now the entire group of participating students will be conducting a common zoological study of four habitats, each individual student team being responsible for one habitat. It is argued, that the new format should perform better due to optimal alignment of teaching activities that stimulate broader overall engagement of students.

Late in 2008 the Department of Entomology of the Zoological Museum (ZMUC-ento) at the University of Copenhagen (KU) was asked to run the mandatory field course "Terrestrial Zoology". After two seasons of the field course (summers 2009 and 2010), however, it became clear, that *the design and maintenance of this course at the highest possible pedagogical standard is a very significant challenge*. This article analyzes, why this seemingly basic course is such a challenge. It suggests a new format (program) of the course, largely based on the principles of the Problem Based Learning and Constructive Alignment (in the sense of Barrows; 1986; Biggs; 2003; Biggs & Tang; 2007; Boud & Feletti; 1997; Brooks & Brooks; 1993; Schmidt; 1983).

Course description

Goal

A general purpose of this field course is to expose the biology students of KU to the fascinating diversity of terrestrial animal life exemplified by Danish habitats[1]. After completing the course students should be able to:

1. apply principles of the phylogenetic classification of terrestrial animals;
2. distinguish main groups (types, classes, predominant orders and families) of terrestrial animals;
3. compare habitats and other aspects of biology and ecology of some target terrestrial animals.

Unlike the "classroom course", students are expected to learn through their own field experience as much as possible, primarily by observing, collecting and identifying target animals during field excursions and subsequent laboratory-based work at the field station (Fig. 12.1.c. and 12.1.d).

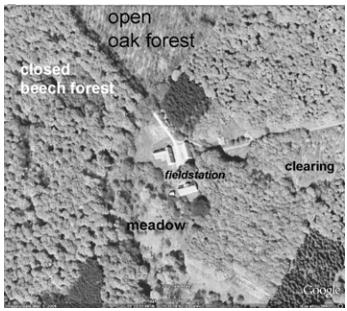
Examination

Student's performance at the course is evaluated by means of the multiple choice questionnaire given to each student. The questionnaire includes 20 questions with 1 right answer out of 4 possible.

Location and practicalities

"Terrestrial Zoology" is held at "Kristiansminde", the field station surrounded by a variety of habitats (Fig. 12.1.a). Each course lasting 3 days is run by 3 instructors. Altogether there are ca. 150-170 students per year. So, they are divided into 8 groups. Usually, each group of instructors teach two courses (two groups of students) in a row (1 full week of work), educating ca. 40 students altogether.

[1] See also: http://sis.ku.dk/kurser/viskursus.aspx?knr=110820&languageid=1



a: Kristiansminde fieldstation and surrounding habitats

b: Mini-lecture by the course instructor

c: Collecting and observing animals by students in the field

d: Work in the laboratory: students are divided into teams, each team working together

Fig. 12.1. Field station, teaching, and student work

Initial format for the course: experience of the first two years

Although the format of "Terrestrial Zoology" somewhat varied from one to another team of instructors, collecting specimens in nature (Fig. 12.1.c) and their study (mostly identification) in the laboratory (Fig. 12.1.d) always stayed as a main activity. Mini-lectures given by instructors in nature (Fig. 12.1.b) or in the laboratory; course Compendium; course library and syn-

optic collection; as well as the Internet were the additional media, where students were getting information supplementary to their practical work. Normally a working day of the course started at 9 am (soon after breakfast), and lasted through the evening even after dinner. All instructors supervised all students: there was no formal assignment of a particular instructor to particular group(s) of students, or other *formal and strict* division of teaching load among instructors. The field course was generally run as follows.

Day 0, evening arrival of the students, informal gathering.

Day 1 in the morning, after the introductory lecture about the course goals, methods and target animal groups, students were led to the excursion in the meadow and forest near the station. There they were collecting their first sample of animals and listening to the improvised mini-lectures given by instructors about the biology of the animals found. After lunch, the rest of the day was spent in the laboratory identifying animals. During this day, the entire group of students was divided into four teams, each team working together at the same workstation (Fig. 12.1.d).

Day 2 Each team of students was assigned with the mini-project (examples of miniprojects: "Fauna of forest floor"; "Fauna of meadow"; "Feeding strategies"; "Coloration"; "Beetles"; "Spiders", etc.); students were collecting and identifying animals, gathering additional information for their mini-projects, and preparing project-related presentations.

Day 3 Delivery of the mini-project presentations by teams of students (10 min of talk, plus 5-10 min discussion for each team); examination; evaluation of the course; clean-up and departure.

Problems of the initial format of the course, and their source

The outlined initial format worked well overall, the course was mostly getting high evaluations by the students. However, we encountered a number of problems that negatively affected the efficiency of the course. *These problems were: varied degree of engagement of the students into the course activities; low motivation of some of them; varied degree of student's performance at the mini-projects presentations day and multiple-choice exam that included low level of learning demonstrated by some of them;* ***very*** *high workload for instructors that made leading two courses in a row a*

physically and emotionally very demanding experience. The main causes of these problems belong to two categories: *objective* and *subjective*. Objective causes are those that come from the conditions and qualities of the course itself. Subjective causes come from the teaching methods applied in certain conditions. Objective causes cannot be changed, but their challengers can be better met by *improved pedagogical techniques*. As regards subjective causes, *these improved techniques* can hopefully completely eliminate them.

Objective causes (1-5):

1. *Very broad topic and very little time*. Within the constraints of 3 days students must get basic but well-structured knowledge about several animal classes, dozens of animal orders; learn their position in the classification, main distinguishing characters and common representatives; some data about their biology and ecology. Students must learn how to collect and preserve animals and how to use identification keys. All this is simply too much for a limited time period! *To succeed, an acceptable level of simplification and generalization of the entire pool of data must be found and all teaching materials (compendium, lectures, reference collection, etc.) must be tuned and aligned to the level of perfection.* We could not achieve that perfect equilibrium within the used format yet.
2. *Need to explain complex concepts even for seemingly easy tasks*. In order to get basic but firm knowledge about terrestrial animals, students must comprehend several rather complex concepts. For example, using zoological classification requires some understanding of the principles of phylogenetic systematics and biological nomenclature that are rather abstract and frequently misunderstood even by professionals. Use of the identification keys assumes familiarity with the respective animal morphology that, for insects alone, is a very complex, structure- and terminology-rich subject. The most efficient way of presentation of these concepts at the appropriate level was not found.
3. *Most of students have background remote from field biology*. Based on 2 years of experience with the field course, I can firmly state, that students are interested in nature, and they want to learn. With very rare exceptions they had fun having this course. But, also with very rare exceptions, their level of preparation for the field of organismal biology is very low: it is hard to believe, but most of them, at the beginning of the

course, could not distinguish an oak from a beach, and a beetle from an earwig, and similar so common types of organisms! It is a challenge of this field course to get modern city-dwelling students closer to nature.

4. *Uneven academic level of the students*. When students were divided into teams for their mini-projects, it was unavoidable that they grouped themselves so, that teams greatly varied in academic strength, motivation and work discipline. These teams performed differently throughout the course, and quality of their resulting mini-projects, collections and exam results varied significantly. Strong teams were stronger in everything, whereas weak, less motivated teams were respectively weaker in everything. The initial format of the course did not stimulate weaker teams to perform better and catch up with stronger students. Also, it did not particularly stimulate instructors to work more with the weaker teams in order to level up an *overall* performance of all students in the group.
5. *Too many variables affecting the course*. Nature itself makes the course a challenge. Extended rain, drop of temperature, cold nights, and other common features of Danish summer may decrease the amount of insects and other invertebrates easily available for 4 collecting during short excursions, and thus cause a problem for a course that lasts 3 days only.

Subjective causes (6-10)

6. *Lack of a single goal (unifying idea) amalgamating all practical activities of the course*. The initial format of the course was strongly tied to the classical, morphology-based systematics and identification of animals. Mini-projects added some general biological content to the agenda of the course, but they were only peripherally tied to the identification process. No matter how we, instructors, love our subject of systematic zoology, the reality is, that unlike 60-40 years ago, systematics is no longer a clear-cut realm of biology and biological education. It is deeply amalgamated within the evolutionary biology, a synthetic subject that arose during the last half-century. It is only *a minority of students who have genuine and deep interest to the systematics-related knowledge* and systematic activities *per se. The majority of students find systematic zoology itself too special and too difficult subject to learn*. They are not committed to invest an effort into learning systematics, when they are unable to comprehend its broader biological

applications. So, it is necessary to find a holistic aspect for the course, some general idea that does involve systematics, but, at the same time, is interesting for the *majority of students*, not only for the elite.

7. *Loosely defined course agenda*. Shortage of time and the outlined complexity of the subject taught make structuring the course very difficult, *especially of the introductory first day*. The information-rich introductory lecture delivered that day was hard to digest, and it was only indirectly connected with the field activities immediately to follow. Lack of a clearly defined goal of all field and laboratory activities did not affect self motivated and interested students. However less motivated students, not being guided by a clear working protocol, took passive approach from the beginning, and thus had smaller chance to get interested later, by doing something and finding that to be engaging. Lack of the clear working protocol for the course could be argued as an advantage, giving the course some flexibility. The problem is that such flexibility seems to be an advantage of a longer course, whereas our short course does not provide enough time for that.
8. *Poor alignment of course elements*. Although it is was expected that the DAY 1 was a "warm up" before the mini-project, alignment between the DAY 1 and DAY 2 was loose. Also constructive alignment (in the sense of Biggs (2003); Biggs & Tang (2007)) among the introductory lectures, mini-lectures in nature, mini-projects and students practical work was not straightforward sometimes. Therefore, the so short and precious time available for the course, was not used with the maximal efficiency.
9. *Complex identification keys*. All students of the course had difficulties when they used identification keys in the course Compendium. It is extremely hard to make a key workable and easy at the same time, since even just around the field station the terrestrial fauna of invertebrates is amazingly species-rich. Simplicity of the key comes at a cost of the omission of numerous taxa, that, in turn, makes a key useless. However, the keys can be gradually tuned to the most common local taxa. Making the key as pictorial as possible, and supplementing the key by a synoptic collection, seems to be the way for improvement.
10. *Lack of some teaching equipment*. Although the course overall does not require complex equipment, we were missing two devices. One is a camera connected to the dissecting microscope and a computer/projector allowing to demonstrate a process of the morphological study and dissection of a small animal on a classroom screen to an entire group

of students. Another needed piece of educational equipment was a paired dissecting scope that would allow simultaneous observation of the same object by two people. A couple 5 of such paired scopes would allow us to demonstrate many students various morphological structures relevant for identification on a very efficient individual basis.

New structure of the course: general description

Unlike the earlier structure, the entire group of students (ca. 20 students) has a clear-cut common goal to achieve during 3 days of the course, *that is a comparative faunistic and ecological study of the terrestrial fauna of the four habitats near the field station*: 1) closed beech forest, 2) open oak forest, 3) meadow and 4) forest clearing (Fig. 12.1). For that purpose the entire group is divided in four teams (4-5 students per team), each team working with one habitat. All teams collect animals in their respective habitats by means of the shared standardized collecting protocol consisting of: a) Malaise trap, b) 10 pitfall traps, c) sifting ground-based debris (400-500 g of sifted material to be processed with the Berlese funnel), d) opportunistic, time-calibrated hand collecting in different microhabitats (for example 0.5-1 hour of collecting). Each team sorts the collected samples into morphospecies and identifies them at least to the level of order. Identified material is recorded by each team in a *standardized Excel arc* that accounts numbers of morphospecies per each animal order, and numbers of morphospecies from different orders collected by various methods. Based on that Excel arc, each team produces a basic statistic analysis that describes the fauna of their respective habitat. That statistics must show, for example, which animal orders are particularly species rich and species poor in a given habitat, how are species distributed by microhabitats, which animal groups are better sampled by certain collecting method, etc. Each team delivers their filled Excel spreadsheets to the instructor (for the upcoming summary for all habitats), and uses that statistics in their resulting presentation about the fauna of the investigated habitat. Each team delivers a synoptic collection of morphospecies they have collected and identified to various extent, and a simple eco-faunistic presentation outlining the fauna of the respective habitat (largely based on the collected specimens, but also with reference to literature and internet-based data for some general points). Although students are given some degree of freedom regarding the content and format of the presentation, the structure of the presentations is pre-defined so that reports

about different habitats are compatible for comparison. At the same time, Excel spreadsheets with the filled data from each team (delivered directly to the instructor, at least 2 hours before the "wrap up" session) are used for the summary presentation that compares all explored habitats delivered by instructors after team's presentations. Student presentations, associated questions and discussion, and a summarizing presentation by instructors are held in the classroom as the final wrap-up session followed by the exam and course evaluation.

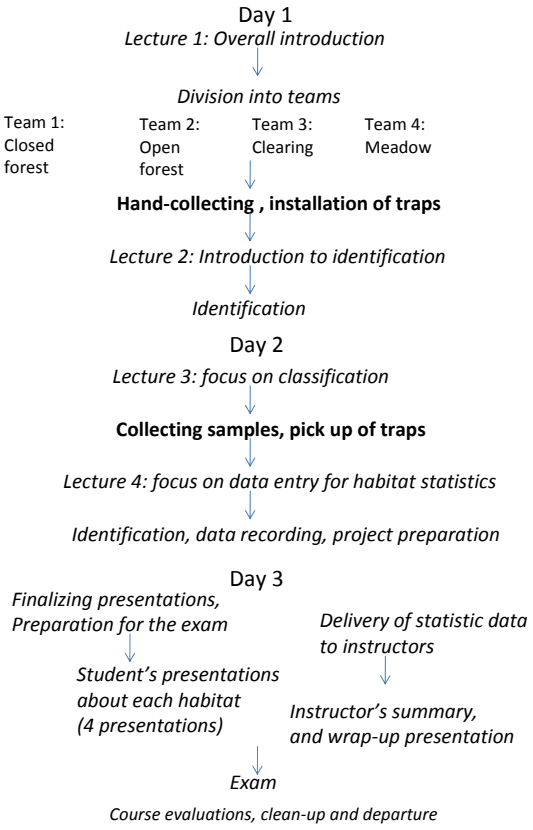


Fig. 12.2. New format of the field course: scheme

Unlike the old structure of the course, each team will be mainly supervised by a particular instructor from the introductory to the final part of the course.

Daily schedule according to new structure

Day 0, evening arrival of the students; informal get-together and introduction of the course. Division into teams.

Day 1 Before lunch introductory lecture 1, division into teams, demonstration of the habitats and collecting techniques, trap installations, hand collecting; after lunch: introductory lecture 2, sorting, mounting and identification of the material in the laboratory.

Day 2 Before lunch: lecture 3 and detailed introduction of the Excel spreadsheet for data recording. Collecting material from traps, and hand collecting; after lunch: lecture 4; continued identification, data recording and data processing in the laboratory.

Day 3 Before 6 lunch: delivery of the summary statistics to the instructors, preparation of the presentations; after lunch: delivery of the presentations by teams, summary presentation by instructors; short discussion; exam (multiple choice) and evaluation of the course; clean-up and departure.

Discussion: how the new format of the course targets the outlined problems

Focusing the whole course on a comparative faunistic-ecological study of several habitats, we maintain collecting and identification as main practical activities of the students, leaving the goal of learning terrestrial animal diversity intact. But we also add a needed unifying goal and central idea to all activities of the course and thus meet the reality that many more students these days are interested in evolutionary ecology than in pure zoology or systematics. The new ecological aspect of the course, that includes *identification of animal as a tool towards bigger goal,* may lure students towards systematic zoology.

Having a research-like goal of the course, we place students in the position of nature explorers giving them freedom of search, what should increase their interest and motivation. At the same time, constraining their

work with a certain standard for data recording built in within the designed Excel arc (data recording form), we supply students with a straightforward protocol for their "research", actually channeling their practical activities. That protocol should also improve time management, preventing students from spending excessive time on particular task (e.g., specimen preparation or identification) and thus helping them to achieve all goals of the course within the very limited available time. That protocol should be particularly helpful for less motivated or less skilled students, who usually perform better if more guidance is provided.

Setting the entire course as a collective research project where each team contributes a piece of data for a common goal (summary comparison of habitats done by instructors), and where instructors are also involved as participants, not only supervisors, raises a level of responsibility for each team. Weaker teams will try to reach the level of performance demonstrated by stronger teams. From the side of instructors, the need of getting compatible results from all teams for the summary presentation will stimulate us to invest more time into more individual work with under-performing teams. Desired paired dissecting scopes would be particularly necessary for exactly this type of work. Common goal for all teams should make each student feeling as part of one big research team throughout the course, such increase of a "team spirit" being always a good thing in the field.

Having a clear and practical goal of the course will help to align all course activities around that, especially lectures given by instructors. Each given lecture will be connected to the previous and to subsequent ones using a progressive sequence of teaching-learning alignment, all of them eventually leading towards making the students able to fill their spreadsheet with the data. Such connection will allow repetitive approach to the most complicated concepts (Fig. 12.3) that are usually difficult to digest in one shot. These are lectures introducing practical aspects of animal morphology and identification that will greatly benefit from applying the projection of the dissection process from under the microscope to the screen. Having the mentioned final goal of comparable taxa lists will also set standard for the keys. Need for a decent list of determined taxa by all teams (not only the best) makes an existence of pictorial key a must.

A standard collecting protocol required by the proposed new structure of the course, that includes a variety trapping techniques used by all teams, will increase the amount of sampled species collected by students. Also, unlike hand collecting, traps always bring some catch, even in the suboptimal weather conditions.

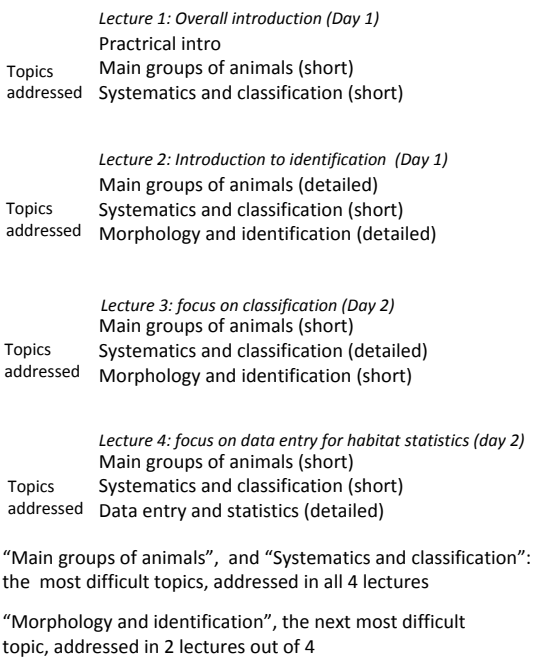


Fig. 12.3. Lectures of the course in the progressive sequence of Teaching-Learning Alignment.

Finally, assignment of an instructor permanently supervising 1-2 teams throughout the course (in the field and laboratory) will increase the room for informal communication of students and instructors, allowing instructors to better see individual abilities of the students and their needs. At the same time, the workload of individual instructor will decrease, leaving energy for equally high engagement throughout the entire week or two of teaching. That structure does not mean that instructors will be restricted to their teams only. Each of them must still operate for an entire group. But, instruction becomes more organized and more channeled.

Acknowledgements

It was great to see during two years, how the "Terrestrial Zoology" course ignites interest to the field biology among students. They are greatly acknowledged for that, especially such rare zoological species as disorganized and non-motivated students. They were really the ones who stimulated changes in our pedagogical techniques. I also thank Henrik Enghoff, Steen Dupont, Thomas Pape and Rasmus Aagaard Jensen, my co-instructors of the course in years 2009 and 2010, respectively, for numerous helpful discussions and small "experiments on humans" we made trying to improve our teaching of the course. Camilla Østerberg Rump and Lars Ulriksen are sincerely acknowledged for critical reading of this project and helpful suggestions that led to its improvement.

13

Oprettelse og evaluering af elementer af kurset Emerging Molecular Techniques in Microbiology – fordele og udfordringer ved at opbygge et kursus omkring et reelt forskningsprojekt

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Indledning

Formålet med dette projekt er, at redegøre for de overvejelser, vi som undervisere gjorde os under udformningen af kurset Emerging Molecular Techniques in Microbiology (EMTM). Dette kursus udmærker sig ved at være opbygget omkring et "ægte" forskningsprojekt, med hovedvægt på, at de studerende bliver introduceret til, og selv får praktisk erfaring med, de nyeste teknikker anvendt i molekylær mikrobiologi. Vi vil redegøre for, hvilke aspekter af undervisningen vi ønskede at lægge mest vægt på og derfor byggede kursets elementer op omkring. På baggrund af dette blev læringsmålene defineret. Efter afholdelse af kurset, foretog vi mundtlige og skriftlige studenterevalueringer. Disse vil blive brugt til at analysere, hvorvidt det er muligt at opbygge et kursus som et rigtigt forskningsprojekt, samt hvilke dele der fungerede godt og hvilke, der kan forbedres. Endvidere vil vi vurdere læringsmålene, med henblik på, om der er alignment mellem disse og de studerendes – og vores – opfattelse af de studerendes læring. Projektet er opdelt i to dele; en beskrivende, der introducerer forhistorien og intensionerne med kurset, samt de logistiske og pædagogiske udfordringer og overvejelser, vi foretog, og en evaluerende del med udgangspunkt i mundtligt og skriftligt feed-back fra de studerende.

Planlægning – fra idé til virkelighed

Forhistorie

Kurset EMTM er et kandidatkursus på Biologi, og en del af kompetenceprofilen "Mikrobiologi", med forankring i "Sektion for Mikrobiologi". EMTM er et 7.5 ECTS kursus og blev afholdt første gang i Blok 4, 2010. Kurset erstatter "Molecular Microbial Ecology" (MME). MME har længe været en del af sektionens kurser og blev i sin tid udbudt hvert andet år. Oprindeligt indeholdt dette kursus både en praktisk og en teoretisk del, men med ændringer i studiestrukturen (indførelse af blokstrukturen og skemagrupper) blev det umuligt at bevare denne form. Forskellige tiltag blev forsøgt, herunder at slå kurset sammen med "Microbial Ecology" og opnormere det til 15 ECTS, så den praktiske del kunne bevares, men pga. for lav tilslutning måtte dette droppes. Vi valgte derfor at nytænke kurset, og tage udgangspunkt i det, der gjorde MME unikt; nemlig at det primært var et metodebaseret kursus, hvor man fokuserede på de nyeste, avancerede teknikker i molekylær mikrobiel økologi. Endvidere skulle kurset adskille sig betydeligt fra sektionens andet store kandidatkursus; "Advanced Bacteriology", der omhandler selve mikrobiologien frem for det metodiske. Efter samråd med de studerende, der på det tidspunkt var tilknyttet sektionen i forbindelse med andre kurser (heriblandt Advanced Bacteriology), blev ordet "økologi" droppet i titlen; det skræmte angiveligt mange studerende væk, der primært interesserede sig for de mikrobiologiske og metodiske aspekter. EMTM blev godkendt af Studienævnet for Biologi, og dermed kunne planlægningsarbejdet påbegyndes.

Retningslinjer

Følgende retningslinjer blev opstillet for kurset:

- Udgangspunktet for kurset skulle være den eksperimentelle del.
- Det eksperimentelle arbejde skulle afspejle "rigtig" forskning mest muligt, dvs. forsøgene og problemstillingen skulle være ny og resultaterne i bedste fald publicerbare.
- De nyeste teknikker skulle anvendes.
- Den teoretiske del af kurset skulle understøtte det eksperimentelle arbejde, dvs. være direkte relateret til de anvendte teknikker.

- Undervisningen (herunder instruktion af eksperimentelt arbejde) skulle varetages af de mest kompetente undervisere til rådighed, helst dem, der i det daglige anvender disse teknikker i deres egen forskning.
- Evalueringsformen skulle relateres til "rigtig" forskning, derfor skulle de studerende præsentere deres resultater som en videnskabelig artikel, med konkrete begrænsninger i og retningslinjer for længde, indhold og form.

Undervisningsform/elementer

Der var flere grunde til, at vi valgte at opbygge EMTM omkring ovenstående retningslinjer. Først og fremmest ønskede vi, at præsentere de studerende for reel forskning i så høj grad som mulig. Herved ville de blive introduceret til teknikker, der rent faktisk anvendes i førende forskning, og opnå et indblik i og en forståelse for praktisk arbejde, der kunne tjene som specialeforberedende, idet specialet på biologi/biokemi med ganske få undtagelser baseres på eksperimentelt arbejde. Vores forventning var, at kursets aktuelle, metodeavancerede og specialeforberedende karakter ville fange de studerende og inspirere dem til at deltage aktivt i undervisningen. Aktiv deltagelse i undervisningen øger den dybe indlæring, der er at foretrække frem for en mere passiv og udenadslære-baseret indlæring (Entwistle; 1992).

Praktiske laboratorieøvelser er ofte nøje afprøvet, for at sikre en høj succesrate, når de udføres af de studerende. Den primære grund til dette er, at der oftest ikke er tid til at lave tingene om, hvis de mislykkes. I vores tilfælde var der hverken ressourcer eller tid til at afprøve alt inden kursusstart på de aktuelle prøver (metode-optimering blev udført), hvilket uundgåeligt vil medføre en lavere succesrate. Men dette giver også de studerende en indsigt i rigtig forskning (alt virker ikke første gang) og inspirerer til "problembased learning": det virkede ikke: hvorfor og hvad kan vi ændre? Men dette kræver en høj grad af fleksibilitet, både fra studerende og læreres side.

En yderligere fordel ved at opbygge kurset om et forskningsprojekt er, at en meget deduktiv struktur i kurset undgås. En sådan struktur ville indebære, at generelt stof blev introduceret først efterfulgt af det mere specifikke (Jakobsen; 1999). Dette ville være den "logiske" måde at opbygge et sådan kursus på, og den er ofte anvendt i naturvidenskab. På trods af dette er denne opbygning ikke indlæringsmæssig fordelagtig, idet det første, abstrakte stof bliver svært at forstå uden den senere konkrete del (Jakobsen;

1999). Ved vores opbygning med centrering omkring et reelt projekt, kunne vi opnå en mere blok-agtig, induktiv struktur, hvor temaer (teknikker) styrede forløbet, og de studerende relativt hurtigt fik hands-on erfaring med stoffet. Desuden blev stort set alt gennemgået stof direkte anvendt kort tid efter, at det blev introduceret.

Det blev bestemt, at kurset skulle indeholde tre elementer: forelæsninger, diskussionstimer med artikelpræsentationer og praktiske øvelser. Antallet af forelæsninger blev holdt på et minimum – disse skulle primært introducere de anvendte teknikker. På trods af, at forelæsninger kan opbygges så de resulterer i et tilfredsstillende/stort læringsudbytte for de studerende, er den klassiske forelæsningsform (45 min enetale fra underviser) ikke læringsmæssig fordelagtig (Gibbs; 1981). Tidsmæssigt var der heller ikke plads til meget teori i form af forelæsninger. I stedet indlagde vi en række diskussionstimer, hvor de studerende individuelt fremlagde en metoderelevant artikel efterfulgt af plenumdiskussion. Herved kunne vi øge aktiviteten af de studerende, hvilket fører til en dyb indlæring (Entwistle; 1992) og desuden træne dem i, at fremlægge en videnskabelig artikel, hvilket var relevant for den valgte eksamensform (se senere). Eftersom de metoder, der skulle bruges i de praktiske øvelser, var relativt avancerede, kom disse til at diktere tidsplanen for resten af elementerne – dvs. forelæsninger og diskussionstimer blev ofte passet ind, når der var pause i øvelserne grundet inkubation af prøver eller lignende.

Eftersom vi ønskede at inddrage de mest kompetente og erfarne lærerkræfter, blev mange lærere involveret i faget (8 i alt). Ofte havde disse en forelæsning om en eller flere teknikker, guidede artikeldiskussionerne og/eller var ansvarlige for instruktion under den praktiske udførelse af teknikkerne. Dette gav en del logistiske og planlægningsmæssige udfordringer, og stillede store krav til informationsniveauet på kurset, da de studerende godt kan blive forvirrede over at møde mange forskellige lærere.

Valg af "case"

Eftersom vi havde besluttet, at det eksperimentelle arbejde skulle afspejle "rigtig" forskning mest muligt, valgte vi en problemstilling, der ikke tidligere er undersøgt med de anvendte teknikker; Forekomst af bakterier i permafrost jord, herunder bestemmelse af disses aktivitet ved forskellige temperaturer. Dette skulle belyses vha. flg. teknikker: sekventering, kvantitativ PCR, microarray, fluorescent in situ hybridization (FISH) og anvendelse af

div. bakterielle farvningsmetoder; totaltællinger og aktivitetsmålinger vha. flow cytometri.

Det er tanken, at "casen" skal udskiftes hver år, således at vores ønske om, at resultaterne i princippet er direkte publicerbare, fortsat kan efterkommes. De studerende arbejde i laboratoriet 3-personers grupper; hver gruppe håndterede et replikat af alle prøver, hvorfor alle var afhængige af hinandens resultater. Databehandlingen måtte gerne foretages fælles i grupperne, men den endelige afrapportering (afsluttende artikel) skulle skrives individuelt.

Valg af eksamensform

Da vi ønskede at relatere kursets indhold så meget som muligt til "rigtig" forskning, valgte vi en evalueringsform så tæt herpå som muligt; de studerende skulle individuelt skrive en videnskabelig artikel efter definerede rammer (max. antal ord og figurer mm). Denne artikel skulle præsenteres ved en mundtlig eksamen, der skulle baseres både på fremlæggelsen af/spørgsmål til artiklen og på generelle spørgsmål til det gennemgåede materiale. Artiklen og den mundtlige præstation ville hver tælle 50% i den endelig karakter.

Det bør altid tilstræbes at opnå *constructive alignment*, hvilket indebærer at evalueringsformen (eksamen) afspejler den måde, hvorpå de studerende er blevet undervist i forløbet (Biggs; 1999). I vores kursus var det umiddelbart svært direkte at efterkomme dette; tidsrammerne tillod ikke, at de studerende afleverede og fik respons på skriftlige opgaver (dette kunne have været "mini-artikler" eller dele af artikler/artikelafsnit) undervejs og dermed blev trænet i den skriftlige del af eksamen (dvs. artikelskrivningen). Via individuelle artikelpræsentationer efterfulgt af plenumdiskussioner kunne den del af eksamen, der bestod i fremlæggelse af egen artikel, dog øves. Eftersom alle de studerende blev forventet at læse alle de præsenterede artikler, burde de også her opnå en fortrolighed med opbygningen af sådanne (hvis de ikke allerede da havde erhvervet den via andre kurser).

Selvstændighed/ejerskab og didaktisk kontrakt

Den valgte undervisningsform lagde i høj grad op til stor selvstændighed fra de studerende. Da kurset ligger sidst på det valgfrie år af kandidatuddannelsen i Biologi og kompetenceprofilen i Mikrobiologi, mente vi, at de studerende ville være klar og rustet til dette (vi er naturligvis klar over, at

ikke alle følger de "normale" studieplaner). Selvstændigheden bestod i at de studerende selv skulle finde supplerende litteratur, og andre oplysninger til brug i artikelskrivningen, samt at de i laboratoriegrupperne var afhængige af alle gruppers databehandling og resultater, som de selv måtte dele i "Absalon". Dette stillede selvfølgelig krav til disciplinen hos alle hold. Endelig var det op til de studerende selv, at udføre databehandlingen og udvælge de vigtigste resultater til præsentation i eksamensartiklen. Med denne undervisningsform tvinges de studerende til aktiv deltagelse og de opnår et øget ejerskab overfor det aktuelle stof, hvilket begge dele øger den dybe indlæring (se ovenfor). Men sådan en undervisningsform kan også opleves som frustrerende og rodet af nogle studerende, der ikke føler sig på sikker grund.

Det blev fra starten gjort klart, at kurset var meget ambitiøst, med hensyn til den mængde penge, der blev postet i øvelserne samt den ønskede kvalitet af resultaterne (at disse skulle bruges efterfølgende). Dette formodede vi ville øge de studerendes engagement.

For at understrege, at vi forventede aktiv deltagelse og selvstændighed fra de studerende, formulerede vi en didaktisk kontrakt, som blev præsenteret til første forelæsning. Formålet med en didaktisk kontakt er at have så klare linjer som muligt med hensyn til hvad der kan forventes fra hhv. studerende og lærere – en slags spilleregler, der tjener til at specificere begge spilleres forpligtelser (Winsløw; 2006). Denne lød således:

The teachers are expected to:
- Introduce new techniques and papers regarding the involved topics
- Guide and assist in practical exercises
- Answer questions

Students are expected to:
- Be on time
- Read all introduced literature
- Find additional information independently
- Be actively involved in discussion classes and practical work

Målbeskrivelse

Målbeskrivelsen (læringsmålene) har til formål at redegøre for, hvad de studerende skal kunne med indholdselementerne i et kursus, og inkluderer ofte flere niveauer af Blooms kognitive taksonomi (Bloom; 1956), der spænder fra viden over forståelse, anvendelse, analyse og syntese til vurdering (Grønbæk & Winsløw; 2004; Herskin; 1995). De lave niveauer af denne

taksonomi er ofte basis for kompetencerne opnået obligatoriske bachelorkurser (første 2 år på Biologi) og de højeste niveauer inddrages senere hen (i særdeleshed i kandidatkurserne).
Til EMTM formulerede vi flg. målbeskrivelse:

By the end of the course students are expected to be able:

- To describe the diversity in microbial communities in natural environments.
- To explain the interactions within bacterial communities.
- To use the course curriculum to hypothesize problems in microbial ecology and design experiments to examine the hypothesis using molecular techniques.
- To use, compare and criticize the different bacterial fingerprinting techniques described in the course.
- To explain in detail and evaluate techniques such as DNA sequencing, RT-qPCR, DNA microarray, metagenomics, and FISH; and to evaluate which of the molecular techniques are most suited to use in different situations.
- To discuss, present, put into perspective and criticize original microbial research papers.
- To write an original scientific paper based on data from the molecular techniques used and described in the course.

Evaluering

Efter afholdelse af EMTM kurset foretog vi en skriftlig evaluering. Denne tog udgangspunkt i de 10 obligatoriske fakultetsformulerede spørgsmål/udsagn, samt 21 ekstra, som vi selv formulerede. Der var 13 studerende, der gennemførte kurset (kun én fulgte kurset men droppede eksamen) og 11 svarede på evalueringsskemaet. Desuden blev der gennemført mundtlige interviews med 2 studerende. Med udgangspunkt i evalueringssvarene vil vi i de flg. afsnit vurdere, hvorvidt kursets struktur og opbygning fungerede efter hensigten samt evaluere eksamensformen. Vi vil desuden undersøge de studerendes opfattelse af alignment mellem målbeskrivelsen og de egentlige kompetencer, de tilegnede sig, og sammenholde dette med vores egen opfattelse af alignment.

Struktur/undervisningsformer

Den generelle feed-back på den primære intension om, at kurset skulle afspejle rigtig forskning mest mulig var meget positiv. Dette blev i mange tilfælde i evalueringsskemaerne nævnt som det bedste ved kurset:

> One of the two best things was:
> - The practical exercises were well planned and were of high relevance.
> - What we have done in the lab is directly related to what's going on in the "real" scientific world.
> - Meget stor praktisk del – man fik virkelig brugt teknikker, man ellers kun har læst om.

En af konsekvenserne af at opbygge kurset omkring et forskningsprojekt var, som tidligere nævnt, at den praktiske del blev relativt stor og styrende. De studerende oplevede angiveligt ikke dette som et stort problem (figur 13.1), selvom nogle gav udtryk for, at den praktiske del var stor og den teoretiske lille. Der var dog ingen, der valgte mulighederne "for stor" eller "for lille" i nogle af disse spørgsmål.

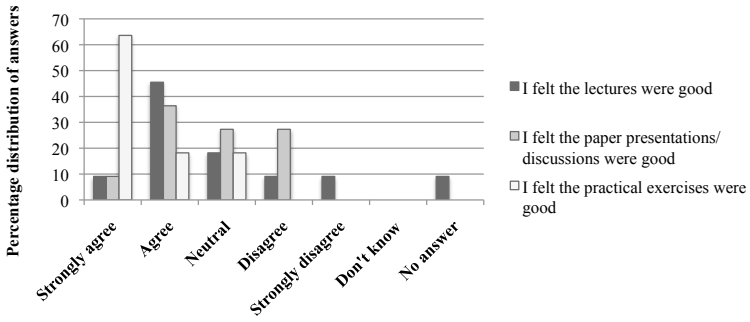
	Far too small	Small	Adequate	Large	Far too large	Don't know	No answer
In my opinion, the fraction of the course spent on the practical part was	0%	9,1%	63,3%	18,2%	0%	0%	9,1%
In my opinion, the fraction spent on the theoretical part was	0%	45,5%	54,5%	0%	0%	0%	0%

Figur 13.1. Udtræk fra evalueringsskema vdr. fordeling af praktik of teori

Det var også den praktiske del, der blev betragtet som den bedste blandt de studerende, hvorimod opfattelsen af forelæsninger og diskussionstimer som gode fordelte sig nogenlunde ligeligt (figur 13.2).

Størstedelen af de studerende oplevede en god sammenhæng mellem de forskellige kursuselementer. I udsagnet "*I experienced a good coherence between the various course elements (lectures, practical work, paper presentations/discussions etc.)*" erklærede 18.2% sig stærkt enige, 63.6% enige og 18.2% sig uenige.

Den praktiske del bestod både af det egentlige laboratoriearbejde og en stor mængde databehandling, da de anvendte teknikker genererede store



Figur 13.2. Procentvis enighed i udsagnene: "*I felt the lectures / paper presentations+discussions / practical exercises were good*". Udsagnene er angivet til højre i figuren.

datamængder. Der var bred enighed om at øvelsesvejledningen til laboratoriearbejdet var præcis og grundig; i udsagnet *"The manual for the practical exercises was precise and contained adequate information for conducting the methods "* erklærede 9.1% sig stærkt enige, 81.8% enige og 9.1% neutrale. Til gengæld følte mange, at de manglede vejledning til databehandlingen; 45.5% var stærkt enige i, at det ville have været rart at have en skriftlig manual, der kunne give hjælp og retningslinjer i denne proces. Databehandlingen fremhæves også som en af de to værste ting ved kurset adskillige gange:

One of the two worst things was:

- The lacking information about how to handle/interpret/work with such large amounts of data processed by the various techniques we used.
- Data handling was a big mouthful and we were pretty much expected to know what to do and how.
- Data behandlingen var alt for selvstændig, man manglede virkelig introduktion til hvordan man trækker oplysninger ud af data, især i pyrosekventeringen.
- Data analyse kunne godt have brugt lidt mere information.

Samlet vurdering

Vores vurdering, baseret på ovenstående er, at det lykkedes at lave et velfungerende kursus, baseret på rigtig forskning opbygget omkring et forskningsprojekt. På trods af visse frustrationer, specielt i databehandlingsprocessen, reagerede de studerende meget positivt på den praktiske del af kurset. Vi vil næste år forbedre vejledningen under databehandlingen, ved tilføjelse af korte, instruerende præsentationer eller en skriftlig vejledning opbygget som en guide/øvelsesvejledning. Dette skal dog gøres, så ansvaret for egen læring bibeholdes. Vil vi desuden indføre nogle "spørgsmål og svar" sessioner i den periode, de arbejder selvstændigt med data, hvor alle lærere er tilstede (se mere nedenfor).

Lærerinvolvering

Som tidligere nævnt var mange undervisere involveret i kurset for at opnå højst muligt erfarings- og kompetenceniveau. I de to interviews blev dette diskuteret; det blev dog ikke opfattet som rodet eller forvirrende. Der blev bl.a. sagt:

- Det var ok, for de havde hver deres klare ansvars- og ekspertiseområder
- Det var godt – viser højt niveau af ekspertise. Det er dog meget vigtigt med en tydelig opdeling af ansvarsområder.
- Det ville nok hjælpe med spørgetimer, hvor alle var tilstede. Dette ville også kræve mindre individuel vejledning; vi slipper for at opsøge jer, og I slipper for, at vi kommer rendende individuelt eller i grupper.

Af den skriftlige evaluering fremgik det, at lærerengagementet generelt blev betragtet som værende højt, og at det tydeligt fremgik, hvad der blev forventet af de studerende (figur 13.3).

Samlet vurdering

På baggrund af dette bibeholder vi de mange lærere på kurset og opretholder dermed det høje niveau af ekspertise; vi vil dog til første (intro) forelæsning klart specificere de enkelte underviseres ansvarsområder. Vi vil desuden indføre "spørgsmål og svar" sessioner med samtlige lærere tilstede. Vi kan konkludere, at den didaktiske kontrakt har opfyldt sit formål, idet hovedparten af de studerende føler, at forventningerne til dem blev forklaret. I denne forbindelse handler dette ikke blot om den didaktiske kontrakt,

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know	No answer
The teachers were engaged and inspiring	27,3%	36,4%	27,3%	0%	0%	0%	9,1%
The teachers were good at explaining what they wanted from the students	9,1%	54,5%	18,2%	9,1%	9,1%	0%	0%

Figur 13.3. Udtræk fra evalueringsskema vdr. lærerengagement og -forventninger

der blev skrevet og præsenteret for de studerende (se ovenfor), men også om krav formuleret undervejs i undervisningen, og som ikke bliver nedfældet som en kontrakt (Winsløw; 2006).

Eksamensform

Som diskuteret ovenfor, var det ikke muligt at nå direkte *constructive alignment* mellem undervisningsformen og eksamen – dvs. at træne de studerende i at skrive en videnskabelig artikel undervejs i kurset. På trods af dette, blev denne form rost meget, og nævnes flere gange som en af de to bedste ting ved kurset:

> One of the two best things was:
> - That the course involved writing a scientific article at the end.
> - Training in writing scientific paper.
> - It has been interesting to try and write a scientific paper.

Og én skriver afsluttende:

> Thank you, especially for individual scientific paper writing. It would be nice if students get comments about the paper.

Det er bemærkelsesværdigt at artikelskrivningen forgik uden lærerstyring, hvorfor ansvaret herfor udelukkende var lagt ud til de studerende.

Samme opfattelse fremgår af to andre udsagn i evalueringsskemaet, se figure 13.4: Denne holdning afspejledes endvidere i de mundtlige interviews; at det var sjovt at prøve at skrive en videnskabelig artikel, men det ville have været rart med mere feed-back på dem end en karakter.

Den generelle holdning blandt de studerende var, at eksamensformen var passende til at demonstrere deres opnåede kompetencer. I udsagnet "*The combination of writing a scientific paper and having an oral examination is suitable to demonstrate the competences I obtained during the*

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
Writing a scientific paper was useful because I learned to independently select and prioritize which results to present	45,5%	36,4%	0%	9,1%	0%	9,1%
Writing a scientific paper was useful because it trained me in this way of communicating scientific results	27,3%	54,5%	0%	9,1%	0%	9,1%

Figur 13.4. Udtræk fra evalueringsskema vedr. artikelskrivning

course" erklærede 27,3% sig stærkt enige, 45,5% sig enige, 9,1% var stærkt uenige og 18,2% svarede "ved ikke".

En enkelt efterlyser en specifikation af, hvad der kræves til eksamen under punktet med forslag til forbedringer af kurset: *Specify what you want for the oral exam*.

Samlet vurdering

På trods af en umiddelbar svag *constructive alignment* mellem undervisning og dele af eksamensformen, var de studerende overvejende positive overfor eksamensformen, hvorfor denne bibeholdes. Vi vil dog forsøge at specificere, hvad de reelt skal kunne tydeligere end det blev gjort i år. Desuden vil vi give mere feed-back på artiklen – enten i form af et notat, de får udleveret efter eksamen, eller en fælles afsluttende plenumsession efter eksamen.

Selvstændighed/engagement

Kurset EMTM krævede en høj grad af selvstændighed fra de studerende, hvilket, som tidligere nævnt, kan føre til en øget aktivitet og ejerskab over stoffet blandt de studerende, og dette vil resultere i en dyb læring. Men omvendt kan det også medføre frustrationer. I vores tilfælde var det vanskeligt at teste, hvorvidt denne øgede selvstændighed medførte en dybere og bedre læring. Vi forsøgte dog med udsagnet: "The teaching form with less teacher control and more student independency gave me a higher learning yield". Kun 9.1% erklærede sig stærk enige i dette, 54,5% var neutrale og 36,4%

var uenige, hvilket må tolkes som et udtryk for, at de studerende ikke umiddelbart opfattede denne selvstændighed som positiv for deres læring. Dette hænger muligvis sammen med problemerne, de studerende oplevede under deres databehandling, hvor flere har givet udtryk for, at de følte sig overladt til sig selv. Flere studerende påpeger også dette, som en af de værste ting ved kurset:

> One of the two worst things was:
> - The lacking information about how to handle/interpret/work with such large amounts of data processed by the various techniques we used. For students that have not worked with the methods before the assumption that it is obvious what to do with such vast amounts of data is bordering something that could be regarded as laziness from the teaching staff.
> - Data handling was a big mouthful and we were pretty much expected to know what to do and how.

Engagementet blandt de studerende blev diskuteret i de to interviews. Her blev bl.a. sagt:

- Laboratoriearbejdet fungerede fint. Gruppen (både 3-mands gruppen og hele holdet) fungerede fint. Vi ventede ikke meget på hinanden og niveauet var generelt højt.
- Det er ikke alle, der har læst artiklerne, der bliver præsenteret, og derfor deltager de ikke i diskussionerne. Udpeg en opponentgruppe, der skal have forberedt kritiske spørgsmål – så er der flere, der deltager.
- Fint engagement, især pga. lille hold.
- Stram op med hensyn til Databehandling og indfør gerne nogle deadlines for, hvornår gruppernes behandlede data skal være uploaded.
- Det, at grupperne er afhængige af hinandens resultater, giver et godt sammenhold, men også frustrationer, når man skal vente længe på hinanden.

Samlet vurdering

Vi vil stadig tilstræbe en høj grad af selvstændighed på kurset, da vi mener, dette resulterer i både øget engagement og bedre læring. Vi vil dog, som tidligere nævnt, guide de studerende bedre gennem databehandlingsdelen. Vi vil endvidere indføre de foreslåede tidsfrister for, hvornår gruppernes resultater skal være tilgængelige for alle på "Absalon".

Det er også vores opfattelse, at der generelt var et højt engagement på kurset. For at øge dette yderligere, vil vi indføre opponentgrupper til artikeldiskussionerne.

Alignment mellem læringsmål og aktuelt udbytte

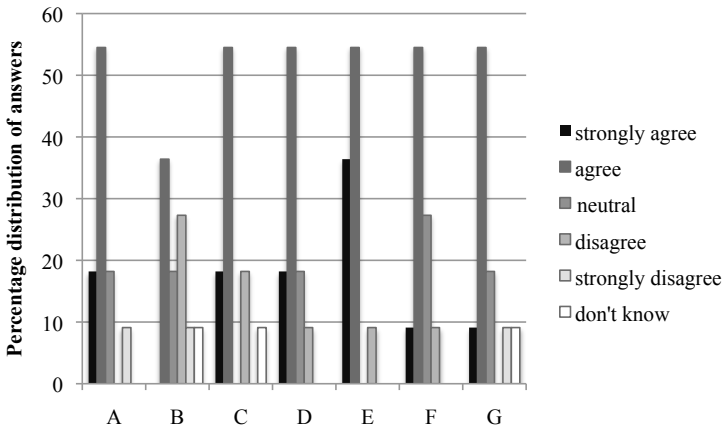
De studerende blev bedt om at vurdere læringsmålene samlet og hvert enkelt. Vi indførte selv denne enkelte vurdering for mere specifikt at få påpeget, hvor der var brug for ændringer. I udsagnet: *"I experienced a good correspondence between the teaching and the course objectives"* erklærede 81,8% sig enige, resten (18,2%) var neutrale.

Svarene i udsagnet afspejler, hvorvidt de følte, de ved at følge kurset, havde erhvervet de ønskede/forventede kompetencer. Svarene er angivet i figur 13.5. Læringsmålene de studerende skulle forholde sig til er som følger:

A Describe the diversity in microbial communities in natural environments.
B Explain the interactions within bacterial communities.
C Use the course curriculum to hypothesize problems in microbial ecology and design experiments to examine the hypothesis using molecular techniques.
D Use, compare and criticize the different bacterial fingerprinting techniques described in the course.
E Explain in detail and evaluate techniques such as DNA sequencing, RT-qPCR, DNA microarray, metagenomics, and FISH; and to evaluate which of the molecular techniques are most suited to use in different situations.
F Discuss, present, put into perspective and criticize original microbial research papers.
G: Write an original scientific paper based on data from the molecular techniques used and described in the course.

Der var generel enighed blandt de studerende om, at der var god *alignment* mellem det ønskede og faktuelle udbytte af kurset. Læringsmål E var det, de følte, blev opfyldt bedst, mens B blev opfyldt svagest.

Eksamenskarakterer blev givet ud fra, hvorvidt de studerende demonstrerede de i læringsmålene specificerede kompetencer. Der blev givet karakter fra 4 – 12 fordelende sig på 2x12, 4x10, 4x7 og 3x4. Det var vores opfattelse, at de studerende blev testet i og mestrede alle de opstillede læringsmål, undtaget B, hvilket reflekterer at den praktiske case "overrulede" netop dette læringsmål, da denne case ikke omhandlede interaktioner.



Figur 13.5. Figur 2. Procentvis enighed i udsagnet; "*After completing the course, I believe I am able to…*" (se læringsmål på side 158). Svarmulighederne er angivet til højre i figuren.

Samlet vurdering

Vi vil ændre læringsmål B, så dette knytter sig til den enkelte case, dette kunne for dette års kursus have lydt: *Explain the bacterial diversity and activity in permafrost soil*. Resten af læringsmålene bibeholdes uændret.

Afsluttende bemærkninger

Det har været spændende, lærerigt og udfordrende at starte kurset EMTM. Som beskrevet i dette projekt, kræver det en høj grad af planlægning, nytænkning og kommunikation, både i planlægningsfasen, men også undervejs i forløbet. Inddragelse af de mange forskellige undervisere krævede også en øget koordinering og kommunikation. Et metodebaseret kursus er bestemt ikke billigt, så det er også en forudsætning, at der kan afsættes midler til at gennemføre kurset.

Som lærere har det været spændende at prøve kræfter med at planlægge en ny kursusstruktur, og vi mener, at vi har gjort os mange erfaringer

og overvejelser, vi kan drage nytte af i andre undervisningsmæssige sammenhænge. Det har til tider krævet en større indsats end "traditionelt" opbyggede kurser, men dette er også blevet belønnet i form af vores og de studerendes store udbytte.

Det var vores klare opfattelse, at de studerende var glade for kurset; de var engagerede og spurgte meget. Det virker fascinerende på dem, at der arbejdes med avancerede, up-to-date metoder. Denne opfattelse er blevet bekræftet under vores analyse af de mundtlige og skriftlige evalueringer. Vi er endvidere blevet opmærksomme på en række ting, vi kan gøre bedre, som vi vil ændre/indbygge i kurset næste år – vi vil derfor gerne takke dette års studerende på EMTM for deres grundige og konstruktive feed-back.

Del III

Students' learning outcomes

14

Udvikling af bevidsthed om kroppens rolle i læreprocesser på idrætsuddannelsen – en fænomenologisk undersøgelse af studerendes oplevelser i faget kropsbasis

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Indledning

> Jeg møder rigtig mange vanskeligheder, når jeg gerne vil mærke min krop. Instruktionen fra underviseren kan jeg som regel godt forstå. Men jeg kan ikke altid mærke. Jeg kan lige nu i øvelsen mærke, at jeg har en god vejrtrækning. Efter svajeøvelsen frem og tilbage i ankelleddene kan jeg mærke, at jeg til at starte med hang fremover i mine knæ. Nu har jeg fundet mit center. Jeg kan bedst lide at få tingene ind visuelt, men samtidig ved jeg, at jeg også kan lide at sætte ord på og at underviseren siger, at det jeg gør, er rigtigt. Måske hænger det sammen med, at jeg har svært ved at mærke efter. Det er frustrerende og jeg bliver nogle gange ked af, at det er så svært for mig, når jeg ved, at det er så vigtigt og jeg samtidig gerne vil leve af at undervise andre.
> *(Kvindelig studerende på kandidatuddannelsen i idræt)*

Evnen til at kunne sanse og mærke nuancer i sin egen kropslige oplevelsestilstand er et vigtigt grundlag at have, når man som idrætsunderviser skal sætte andre mennesker i bevægelse. Men som det udtrykkes i den kvindelige studerendes beskrivelse ovenfor, er det ikke nødvendigvis nemt at kunne mærke kroppen. Det at arbejde med bevidstgørelse af hvad der sker med en selv, når man gør forskellige bevægelser og indgår i forskellige øvelser, kan idrætsstuderende have stor gavn af, fordi det er vigtigt, at de har en forståelse for, hvordan de processer, de sætter i gang hos andre, kan opleves. Oplevelserne kan nemlig have betydning for både identitetsprocesser

(Winther; 2009) og for sundhed i en bred forståelse.[1] Idrætsuddannelsen lægger dog overordnet ikke meget vægt på den oplevelsesmæssige dimension. Med dette projekt har det, med fokus på praksisfaget "Kropsbasis"[2], derfor været min ambition at undersøge, hvordan man kan arbejde med at bevidstgøre kroppens rolle i læreprocesser i idrætsuddannelsen.

Problematikken har også baggrund i mine og kollegers oplevelser af, at nogle studerendes idrætslige erfaringer giver dem meget fasttømrede opfattelser af, hvad der er værdifuldt at lære og hvordan – som hos mange er funderet i et naturvidenskabeligt paradigme. Det kan vanskeliggøre en åben indstilling til at deltage i undervisningsforløb, der anlægger et mere oplevelsesorienteret perspektiv. Det er dog vores opfattelse, at de studerende igennem at arbejde med metoden "oplevelsesanalyse" (Engel; 2001) bliver bevidste om kvaliteter og egne læreprocesser i de mere æstetisk og humanistisk funderede fagfelter. Dette åbner for spørgsmål i forhold til metodens anvendelse i andre fag. For at kunne argumentere for udbredelse af det oplevelsesorienterede perspektiv på uddannelsen, vil det være nødvendigt nærmere at undersøge, hvilken betydning fokus på kropslig indlevelse kan have for studerendes læreprocesser, og hvordan man kan bevidstgøre og formidle kropslige oplevelser.

Ovenstående indledende refleksioner leder mig frem til følgende forskningsspørgsmål for projektet:
Hvilken betydning kan kropslig indlevelse og bevidstgørelse af studerendes kropslige oplevelser have for lære- og undervisningsprocesser på idrætsuddannelsen?

Problemformuleringen uddyber jeg i følgende underordnede problemstillinger:

- Hvilke fænomener er karakteristiske for studerendes kropslige oplevelser og læreprocesser i "Kropsbasis"?
- Hvilke indsigter kan arbejde med beskrivelse og analyse af oplevelser i idrætspraksis give i forhold til at benytte metoden pædagogisk i andre fagfelter på uddannelsen?

[1] I bogen *Sundhed i bevægelse – udfordringer til et begreb* (Bredahl & Nielsen; 2007) giver forskellige forfattere deres bidrag til en udvidelse af sundhedsbegrebet med udgangspunkt i WHO's fokus på sundhed som både fysisk, psykisk og socialt velbefindende.

[2] Fagets indholds- og målbeskrivelse som det fremgår af SIS er vedlagt som Appendix A (jf. også http://sis.ku.dk/kurser/viskursus.aspx?knr=109239)

Teoretisk baggrund

Det metodologiske og videnskabsteoretiske udgangspunkt for både min undervisning i faget "Kropsbasis" og for dette projekt er kropsfænomenologien. Det er en filosofi, som har rødder i Maurice Merleau-Pontys (1962/2002) forståelse af kroppen som både levende og levet og i kropslige tilgange til at undersøge oplevelses- og erfaringsprocesser beskrevet af bl.a. filosof og krops-psykoterapeut Eugene T. Gendlin (1997). Indenfor denne filosofiske og psykologiske teoriramme kan kropslighed (embodiment) defineres som "den kropslige væren forstået som den fysiske krop, det kommunikative udtryk og den oplevede "følte fornemmelse" af kroppen – på én og samme tid" (Nielsen; 2008). "Den levede krop" forstås som værende "chiastisk" (Merleau-Ponty; 1968/2000), det vil sige, at den både er seende og set, handlende og handlet, oplevende og oplevet af en selv og andre. Metaforisk udtrykt er vi altid sammenvævede med hinanden og vores omgivende verden. Vi påvirker vores omgivelser og bliver påvirket af dem gennem vores kropslighed.

Fænomenologisk forskning begynder altid "in the lifeworld" (van Manen; 1990, p. 7), og har som mål at skabe dybere forståelser af oplevede fænomeners betydning. Et fænomens essens kan beskrives "through a study of the structure that governs the instances or particular manifestations of the essence of that phenomenon" (van Manen; 1990, p. 10). Fænomenologiske første-persons beskrivelser kan hjælpe med at komme ind til essensen af et fænomen ved at synliggøre, hvad en oplevelse rummer for personen. Men for at kunne tolke og forstå *"the 'texts' of life"* (van Manen; 1990, p. 4) fra et tredje-persons perspektiv er det nødvendigt at analysere første-persons beskrivelserne med en hermeneutisk tilgang, hvor fokus er at bevæge sig mellem dele og helheder.

En kropslig undervisnings- og forskningsmetode

Den hollandske pædagog Max Van Manen (1990, p. 163) lægger vægt på, at beskrivelser af "significant moments" er centrale, når vi vil forstå menneskers oplevelser og "lived meanings." Jeg vil sætte fokus på "betydningsfulde øjeblikke" fra de studerendes perspektiv i forskellige undervisningssituationer i faget "Kropsbasis" og skabe viden om sådanne øjeblikke gennem "oplevelsesbeskrivelser" (Engel; 2001; Engel & Winther; 2009) skrevet af idrætsstuderende på 1. år som led i undervisning i faget "Kropsbasis" på blok 1.

I "Kropsbasis" giver vi i forlængelse af en praksistime de studerende som opgave at skrive en oplevelsesbeskrivelse af en situation fra timen, som de synes havde en særlig betydning for dem og deres læreprocesser. Metoden er inspireret af kultursociolog og psykoanalytiker Alfred Lorenzers (1986) "psykoanalytiske dybdehermeneutiske fremgangsmåde" og af sociolog Søren Nagbøls (1994) "oplevelsesanalyse." I min faggruppe har vi videreudviklet metoderne til en idrætslig kontekst (bl.a. beskrevet i (Engel; 2001; Engel & Winther; 2009) med inspiration også fra (Gendlin; 1983, 1997)). Det er vanskeligt at omsætte kropslige oplevelser til verbal form og at forstå en kropsligt-sanselig viden, men Gendlin (1983) beskriver en metode til at komme omkring sprogliggørelsesproblematikken. Ved at give opmærksomhed til "den følte fornemmelse" i kroppen kan vi lære at beskrive en oplevelse som en helhed. Vi kan med metoden ikke *forklare* oplevelsen, men den giver mulighed for at *forstå* og komme tæt på menneskers kropslige oplevelser og meningsskabelse i bevægelsesaktiviteter, som de udtrykkes gennem metaforer, associationer, tanker og følelser.

I studieåret 2009/10 har jeg i blok 1 haft to hold (70 studerende) i "Kropsbasis." De studerende har alle skrevet oplevelsesbeskrivelser umiddelbart efter en undervisningstime med fokus på kropskontakt. Jeg vil i dette projekt undersøge fælles træk i beskrivelserne og udvælge enkelte centrale fænomener til nærmere analyse. Med en hermeneutisk-fænomenologisk analysetilgang (van Manen; 1990) vil jeg undersøge, hvilke temaer/"lived meanings" i forhold til de studerendes kropslige oplevelser og læreprocesser der kommer frem i deres beskrivelser af "betydningsfulde øjeblikke." Gennem deres ordvalg viser de studerende, hvordan de relaterer sig til bevægelsesaktiviteterne, og hvordan de skaber mening i deres oplevelser. Jeg har udvalgt tekstpassager fra de studerendes beskrivelser og samlet dem til narrativer (Polkinghorne, 1988; Sparkes, 2002). Analyser af narrativerne vil lede til diskussioner af, hvordan vi kan skabe bedre muligheder for indlevelse i det kropslige og bevidstgørelse af kropslige oplevelser – også i andre fagfelter.

Den finske danseforsker Jaana Parviainen (2002) skriver, at vi kan skabe mening i en anden persons kropslige oplevelser gennem verbal kommunikation eller gennem kinæstetisk-empatisk forståelse. For at kunne forstå andre menneskers bevægelsesoplevelser fra deres synspunkt, har vi brug for kropslig sensitivitet (Parviainen; 2002, p. 148). Det er vigtigt for en idrætslærer, men det er også vigtigt for mig, når jeg i et forskningsmæssigt perspektiv forsøger at forstå de studerendes kropslige oplevelser. Mine egne kropslige erfaringer kan ikke undgå at have betydning for mine un-

dersøgelser af andres kropslige oplevelser – jeg skaber mening i de studerendes oplevelser gennem min egen kropslighed, og de erfaringer jeg bærer med mig. Den idrætspædagogiske forsker Helle Rønholt (2003, pp. 118–120) understreger på den anden side, at når man benytter en hermeneutisk-fænomenologisk forskningstilgang, bliver det muligt både at undersøge deltagernes oplevelser og at gøre forskerens position eksplicit, fordi man som en del af den hermeneutiske proces redegør for den procedure, hvorigennem ens fund er blevet skabt.

Små klip ind i praksis

Jeg har i første omgang analyseret alle oplevelsesbeskrivelser med en "wholistic reading" (van Manen; 1990, p. 93), hvorigennem forskellige fænomener har vist sig centrale. Jeg har derefter valgt at gå i dybden med to fænomener, som jeg kalder *'et anderledes rum'* og *'at kunne mærke kroppen'*. De to fænomener fremtræder i mange af de studerendes oplevelsesbeskrivelser og jeg har gennem en "selective reading" (van Manen; 1990, p. 93) undersøgt hvilke kvaliteter, der hos de studerende knytter sig til de to fænomener. I det følgende præsenterer jeg uddrag fra oplevelsesbeskrivelserne, hvor jeg har fremhævet centrale ord og sætninger, som jeg går tættere på i den efterfølgende diskussion.

De forskellige uddrag stammer fra tre forskellige opgaver fra den samme time: 1) En hilseøvelse, hvor holdet fik til opgave at foreslå forskellige måder at hilse på med tanke på forskellige kulturer, som de kender til. 2) En kampøvelse, hvor de studerende to og to skulle forsøge at skubbe hinanden til modsatte side af salen. 3) En massageøvelse hvor halvdelen af holdet fik besked på at sætte sig på gulvet med lukkede øjne, og den anden halvdel fik instruktioner i at gå hen til den makker, de hidtil havde arbejdet med i timen, give dem en let massage samtidig med, at de prøvede at mærke efter, hvordan makkerens kropslige respons var – oplevede de, at makkeren følte ubehag, så skulle de ændre deres massage (tegn på ubehag kunne for eksempel være pludselige muskulære spændinger eller rødmen i ansigt). Efter et stykke tid fik de tegn til at gå til en ny makker, dette gentog sig en gang til, og til sidst skulle de tilbage og afslutte med deres første makker.

'Et anderledes rum'

> Der er et eller andet over dansesalen, noget fortryllende. Det er som om vi falder i et med hinanden og der er en *gensidig kropslig forståelse af*

hinanden. Der sker noget med hver enkelt person på holdet og holdet som helhed, som vi går rundt mellem hinanden, ansigt til ansigt med sved på panden og kyssende næser. *Det er som om den usynlige barriere imellem os er brudt*. En barriere man normalt først bryder, efter man har kendt hinanden længe. *Øjenkontakten og den tætte kropslige kontakt er med til, at man føler sig tryggere* og mere forstående i hinandens nærvær og det er okay, at være sig selv uden at skulle have en facade på.
'Mark' september 2009

Jeg træder ind i salen sammen med resten af holdet. Som sædvanlig er jeg nervøs inden de her timer, for som den stereotype boldspiller jeg er, er jeg sikker på at jeg umuligt kan blive god til det vi lærer her. Jeg tager mig selv i, endnu en gang, at have taget indendørssko på, selv om jeg normalt ikke bruger dem i det her fag. Jeg sætter mig på den lille bænk ude langs vinduerne, begynder at binde snørebåndet op, og tager så begge sko af (...) Det lyder så uvirkeligt, men pludselig føler jeg mig så godt tilpas. *Mine bare tæer har kontakt til trægulvet, mine sanser opfanger en masse jeg normalt ikke skænker en tanke.* Jeg er klar. (...) Per og jeg hopper rundt, som var vi midt i kampens hede. *Ingen tænker over hvor dum man nok egentlig ser ud, for fokus er et helt andet sted*. Min modstander må ikke få den fordel, at jeg mister fokus. Intensiteten er høj, og alle går til den, det er fedt at se. (...) Nu har jeg min chance. Jeg rammer ham på hoften, et dødsstød, og jeg har vundet. Pause. *Igen er det ligesom om, at rummet på en måde åbner sig, og alle kommer til syne igen. Vi har alle kæmpet i den her lille osteklokke i hver gruppe, og har ikke ænset de andre.* (...) Det er sjovt som *tiden flyver af sted* i et fag, jeg på forhånd var så skeptisk overfor. Nu vil jeg jo bare fortsætte, prøve at finde ud af endnu mere om min egen krop. Følelsen af at finde sig selv i sin krop, og kontrollere sine bevægelser er fantastisk. Jeg tager mine sko på igen. Timen er slut, og det er blevet tid til at spille bold. Æv!
'Jonas' september 2009

Jeg lægger slet ikke mærke til de andre i rummet. Var der musik? Jeg ved det ikke. Jeg tænker ikke over om folk lugter af sved eller dufter af parfume. *Jeg er inde i mine egne tanker.* Jeg tror endda, jeg støder ind i en på et tidspunkt.
'Signe' september 2009

Opgaven lyder på, at vi ryg mod ryg skal forsøge at skubbe hinanden ud til siderne i rummet. Jeg mærker hvordan Mortens svedige ryg presses mod min, giver efter for mit pres og glider længere ned, som om den forsøger at undvige mit pres. *Jeg ænser ikke de andre i rummet*, som er stillet overfor samme opgave. Hele mit fokus er rettet delvist mod at fuldføre opgaven, og delvist mod det sanselige. At jeg har en fremmed persons svedige

ryg presset hårdt op mod min, en ryg hvor jeg kan mærke alle detaljer, rygsøjlen, skulderbladene og det hurtige åndedræt. (. . .) Opgaven er færdig, jeg vender mig hurtigt om mod Morten og smiler og kigger ham i øjnene, *det er tydeligt at der er skabt en kontakt og en tryghed i vores forhold, på trods at det faktum, at vi under hele øvelsen ikke har haft noget egentlig kommunikation eller sproglig kontakt.* Kun denne kropslige kommunikation, eller leg, som jeg føler det har været. Opgaven bliver ændret til at vi nu i fællesskab skal forsøge at rejse os fra siddende til stående position, blot med ryggen som redskab. (. . .) Gennem denne kropslige kontakt mærker jeg hurtigt i hvilket tempo jeg bør rejse mig, for ikke at forcere og dermed mindste "grebet" og presset fra Mortens ryg. Hurtigt vender jeg mig om og smiler til Morten, ikke kun et smil af fornøjelse over den vellykkede opgave, men også et smil af *overraskelse over hvor hurtigt vores kroppe begyndte at tale samme sprog.* Jeg nærmer mig Morten og giver ham en venskabelig berøring på skulderen, en berøring som føles ganske naturlig kun efter få minutters kropslig kontakt. Men også en anerkendelse af at vi har kommunikeret på et niveau, som jeg ikke kommer til, med ret mange mennesker. *Vi har kommunikeret på et plan, som nedbryder barriere, skaber relation og først og fremmest mærker ens krop, og mærker ens egen krop i forholdet med andre.*
'Jesper' september 2009

Ved berøringens afslutning *er jeg ikke helt den samme*, og mit forhold til giverne, på trods af deres anonymitet, er ændret. *Ved den fysiske kontakt er de kommet tættere på, end det nogensinde ville være muligt gennem verbal kontakt*. Sammen har vi skabt *en nonverbal forbindelse, vi føler hinanden, forstår hinanden, uden at have delt et eneste ord.*
'Marianne' september 2009

Så stopper MUSIKKEN, KAMPEN fløjtes af, det er SLUT. Dryppende af sved griner vi nu til hinanden og kigger rundt til de andre, hele stemningen i dansesalen er løftet. *Vi har skabt et rum her i kropsbasis hvor der gælder andre regler end i samfundet,* andre regler end lige der uden for murerne, vi har skabt et rum hvor der er plads til kropssprog og accept af kropskontakt uden styring af fastlagte rammer og regler. I dette rum og fyldt af denne fælles stemning går resten af øvelserne i timen hurtigt og nemt, og timen slutter alt for hurtigt. Samfundets regler venter igen på den anden side af døren og på trods af at rytme og dans aldrig har sagt mig noget glæder jeg mig for første gang til at stå der igen.
'Filip' september 2009

Jeg begynder roligt at mærke og føle på min partner, klassekammerat, min ven. *Han er rolig*, ikke den mindste beklemthed udtrykker han, på trods af

spændinger i skuldrene, som jeg langsomt tager mig af. *Jeg bliver rolig*, mærker angsten forsvinde og dets spor bliver væk. Hvad var jeg så bange for? Hvem har fortalt mig at livet er besværligt? Jeg ser rundt i lokalet og *mærker hvordan de håndarbejdende individer går i et med oplevelsen af nærvær,* deres øjne ler. Jeg smiler, da jeg går videre til min næste makker. (. . .) Førend jeg ville ønske det, er øvelsen slut. Jeg bliver bedt om at åbne øjnene og *komme tilbage til virkeligheden.* Jeg har oplevet meget i dag. Inde i dansesalen, oppe i mit hoved, har tiden i begyndelsen været gået i stå, men efter frygtens forsvinden har den fløjet af sted, som en trækfugl mod varmere himmelstrøg. *I verdenen udenfor* har tiden dog gået sin vante gang. Jeg tror på min virkelighed.
'Aksel' september 2009

'At kunne mærke kroppen'

(. . .) Jeg har en fortid som Sergent i Hæren, hvor jeg har lært alt andet end yoga og nærhed, og kropsbasis er derfor noget ukendt "yoga-halløj", som kun hippie københavnere dyrker. Men kropsnærhed mellem hinanden er en vigtig del af kropsbasis faget, hvilket vi nu virkelig skal til at tage og føle på. I denne time bliver vi stillet den opgave, at vi skal gå rundt mellem hinanden, og hilse på forskellige måder. "Hvor let kan det være", tænker jeg – men min tanke bliver hurtigt vendt 180 grader – UPS, vi skal jo meget tæt på hinanden. Vi bliver alle instrueret i hvorledes vi skal hilse, først med hånden, dernæst nikke, så med kys på kinden og til sidst med næsen. *På et splitsekund går min krop fra at være kold, til at svede af ren nervøsitet.* Jeg skal nu vha. næsen hilse på hele holdet, som jeg kun har kendt i to uger. Hvordan vil det nu gå? Her bliver den personlige grænse brudt, og man træder i stedet direkte ind i ens intime område. *Koldsveden løber ned af nakken på mig, alle følelser bliver pludselig forstærket, musikken forhøjet;* "CHRIST" tænker jeg. De andre sætter i gang med at gå rundt mellem hinanden og hilse, som om det ikke rør dem. Jeg tager et skridt, efterfulgt af det næste og nærmer mig en fra holdet. Vores hoveder nærmer sig hinanden, vi har øjenkontakt og ved begge, hvad der skal ske. Vores næser møder hinanden, og hilsen bliver givet. WOW vi er tæt, man kan i et kort øjeblik mærke den andens åndedræt, vi befinder os nu i hinandens intime områder, og *jeg kan mærke adrenalinen bevæge sig kraftigt rundt i kroppen*. Vi tager afstand igen, og *hjertet falder lidt til ro*. Puha, et kort men nervepirrende øjeblik, hvor to "fremmede" hilser intimt på hinanden. *Det giver et sug i kroppen og følelsen af at ville prøve igen overtager kroppen.* Timen her har tydeligvis flyttet grænser. Et smil breder sig, det er sgu en fed oplevelse. Jeg er nu ikke i blandt hippie københavnere, men i stedet en del af dem.

'Anton' september 2009

Vi går rundt mellem hinanden og jeg har givet hånden til et par stykker – jeg vil kalde det nogle vellykkede håndtryk, vi kigger hinanden i øjnene, smiler, og trykker lige hårdt. Jeg rækker hånden ud mod den næste person, der går hen mod mig, og trykker med samme styrke, som jeg har gjort ved de forrige personer, men *jeg får hurtigt fornemmelsen af, at jeg maser personens fingre. Jeg får det mærkeligt i maven*, og spørgsmålene popper frem. Klemte jeg for hårdt? Hvorfor klemmer hun ikke hårdere? Kan håndtrykket sige noget om ens personlighed? Betyder et hårdt tryk, at personen er selvsikker, og et blødt håndtryk det modsatte, eller er det at overanalysere? Jeg kigger på personen, forsigtigt smilende, men denne smiler helt naturligt tilbage. *For hende var det et normalt håndtryk*, tænker jeg. Undrende går jeg videre og nu hedder øvelsen, at man skal give hinanden et knus.
'Susanne' september 2009

Allerede inden timen begynder, står både jeg og flere fra mit hold og danser lidt for sjov, måske endda gør grin med det, for vi er sku lidt stive i kroppen. Vore boldspilskroppe, der kun er vant til fysiske taklinger og ikke det, at mærke kroppen og føle hinandens nærvær. *Jeg er i hvert fald kun vant til at føle kroppen, hvis det gør ondt* efter f.eks. en tackling.
'Mark' september 2009

Mit hjerte banker endnu hårdere i brystet og mine håndflader er klamme, værst har mine næse det som pludselig er begyndt at løbe og føles al for stor i mit ansigt. Hvem vil jeg absolut ikke så tæt på? Hvem skal jeg undgå? Jeg er ikke i tvivl om at det er drengene der gør mig mest nervøs og jeg kan umuligt undgå dem alle, *selvom jeg har ændret min gang* og nu *bevæger mig i et uroligt zig-zag mønster*. Et håndtryk føles naturligt, men at stå næse mod næse med mennesker man ikke er intime med føles unaturligt og på en måde væmmeligt. Jeg bliver meget bevidst om min intim grænse. Den er helt tydelig og virker umiddelbart vanskelig for mig at krydse. Hvorfor reagerer min krop som om den bliver angrebet? Mit forsvar er fuldt beredt. Jeg lukker øjnene, tager en dyb indånding og fører mit hoved helt tæt på den første. Spidsen af vores næser mødes og jeg bliver næsten forskrækket. Det føles som om at tiden står stille og jeg tænker tusind tanker. Langsomt begynder min krop at slappe af, *skuldrene falder på plads*, *vejrtrækningen bliver rolig* og jeg tør åbne øjnene. Min grænse er blevet rykket og mit forsvar er sænket. I løbet af 10 minutter har jeg nusset næse med flere forskellige end jeg kan tælle på en hånd og jeg mærker, at det langsomt føles mere og mere naturligt. Ubehaget er forsvundet og jeg slipper min krop fri og lader den gå sin egen spontane gang.
'Mie' september 2009

Diskussion af fremhævede kvaliteter ved fænomenerne

'Et anderledes rum'

I mange af de studerendes beskrivelser fremtræder 'det anderledes rum', der opstår i "Kropsbasisfaget" som en central kvalitet i de oplevelser, som de har valgt at skrive om. Det kommer til udtryk i sætninger som: "Igen er det ligesom om, at rummet på en måde åbner sig, og alle kommer til syne igen" og "vi har skabt et rum her i kropsbasis, hvor der gælder andre regler end i samfundet". Den fænomenologisk orienterede psykolog Will D. Adams (1999) skriver om et fænomen, som han kalder "the sacred". Han beskriver hvordan mennesker bevæger sig ud af deres sædvanlige verden og ind i en anden verden, som bliver en slags "sacred space." Det kan være et afgrænset fysisk rum, det 'rum' der kan opleves mellem to eller flere i et mellemmenneskeligt forhold eller et særligt psykologisk 'rum' (en bevidsthedstilstand). De studerende oplever 'Kropsbasis-rummet' som et andet rum end 'hverdagsrummet' og også end de andre 'idrætsrum', de er en del af på uddannelsen.

Det er karakteristisk for de studerendes oplevelser i 'det anderledes rum,' der skabes i "Kropsbasis," at *kropslig kommunikation er i fokus* ("en gensidig kropslig forståelse af hinanden", "der er skabt en kontakt og en tryghed i vores forhold, på trods at det faktum, at vi under hele øvelsen ikke har haft nogen egentlig kommunikation eller sproglig kontakt", "overraskelse over hvor hurtigt vores kroppe begyndte at tale samme sprog", "en nonverbal forbindelse, vi føler hinanden, forstår hinanden, uden at have delt et eneste ord", den sanselige oplevelse forstærkes ("mine sanser opfanger en masse, jeg normalt ikke skænker en tanke"), fokus er udenfor en selv ("ingen tænker over, hvor dum man nok egentlig ser ud, for fokus er et helt andet sted"), men samtidig er fokus også indadvendt ("vi har alle kæmpet i den her lille osteklokke i hver gruppe, og har ikke ænset de andre", "jeg lægger slet ikke mærke til de andre i rummet", "jeg er inde i mine egne tanker", "mærker hvordan de håndarbejdende individer går i et med oplevelsen af nærvær"). I beskrivelserne fremgår det også, at *tidsfornemmelsen ophæves* ("tiden flyver af sted"), at *relationer udvikles* ("vi har kommunikeret på et plan, som nedbryder barrierer, skaber relation og først og fremmest mærker ens krop, og mærker ens egen krop i forholdet med andre", "ved den fysiske kontakt er de kommet tættere på, end det nogensinde ville være muligt gennem verbal kontakt") og at *læring som forvandlingsprocesser bliver mulige* ("jeg er ikke helt den samme").

De studerende beskriver 'Kropsbasis-rummet' som et sted, hvor oplevelser i et dybere lag end hverdagsoplevelser er karakteristiske. Psykologen Mihalyi Csikszentmihalyi (1975) har fremlagt en teori om oplevelser med en psykologisk tilstand, som han kalder "flow". Denne teori kan hjælpe med at komme dybere i forståelsen af, hvad der foregår i de processer, som de studerende beskriver. I Csikszentmihalyis (1975, pp. 33–55) termer er det karakteristisk for en flow-oplevelse, at den rummer fornemmelsen af *"centring of attention on a limited stimulus field"* og, at *"action and awareness merge."* Det kommer til udtryk i de beskrivelser, der fremhæver det indadvendte nærvær som en kvalitet. Et andet karakteristika ved en flow-oplevelse er *"loss of self-consciousness"* som kommer til udtryk i beskrivelser, der fremhæver det udadvendte fokus. Det er karakteristisk, at de studerende indimellem glemmer sig selv, og hvordan de ser ud. I en flow oplevelse findes også en fornemmelse af at være *"in control of actions and environment."* Men som det fremgår hos de studerende, er det ikke en aktiv, bevidst kontrol, det er kroppen, der 'tager over'.

At kunne mærke kroppen

For at en flow oplevelse kan opstå, må man udfordres, men kun i en særlig grad: "Flow is experienced when people perceive opportunities for action as being mainly matched by their capabilities" (Csikszentmihalyi; 2005, p. 96). Det er væsentligt, at udfordringer kan have meget forskellig karakter – det kan for eksempel være fysiske, sociale, personlige og bevidsthedsmæssige udfordringer. I de studerendes oplevelsesbeskrivelser fremgår det, at de indimellem er blevet udfordret udover deres umiddelbare personlige grænser, men det er interessant, at det blandt andet er i disse situationer, at deres kropslige reaktioner bliver meget tydelige for dem ("på et splitsekund går min krop fra at være kold, til at svede af ren nervøsitet", "koldsveden løber ned af nakken på mig, alle følelser bliver pludselig forstærket, musikken forhøjet", "jeg kan mærke adrenalinen bevæge sig kraftigt rundt i kroppen", "mit hjerte banker endnu hårdere i brystet og mine håndflader er klamme", "jeg har ændret min gang – bevæger mig i et uroligt zig-zag mønster"). De fleste finder strategier til at skabe mening i udfordringen, som hjælper dem med at udholde den og komme om på den anden side som en lille smule forvandlet. For eksempel er der mange, som i "hilseøvelsen" begynder at lægge mærke til, hvordan deres holdkammerater hilser – om de giver et rigtigt knus, eller bare lige markerer, hvor faste deres håndtryk er mv. I de processer lærer de studerende gennem egne oplevelser, hvad de synes er

behageligt og ubehageligt, men de får også en oplevelse af, hvad formålet med at lave øvelsen er. Når de finder en mening med øvelsen, mærker de en kropslig forandring ("hjertet falder lidt til ro", "det giver et sug i kroppen og følelsen af at ville prøve igen overtager kroppen", "skuldrene falder på plads, vejrtrækningen bliver rolig"). I massageøvelsen oplever mange af de studerende en kropslig indlevelse i kraft af, at deres dominerende sans – synssansen – er sat ud af spillet. De bliver opmærksomme på, hvor forskellige de hænder som masserer dem arbejder og på, hvad de selv synes er behageligt.

I de forskellige opgaver i "Kropsbasis" udforsker vi sammenhænge mellem sansning, oplevelse og erkendelse, hvilket er centralt i undervisning med fokus på æstetiske læreprocesser (Engel; 2003). Ofte lægger man kun mærke til kroppen, når noget i den gør ondt, eller den ikke fungerer optimalt (Shusterman; 2008, p. XI). I de studerendes beskrivelser fremgår det, at de i de opgaver, de kommer igennem i "Kropsbasis," bliver meget mere opmærksomme på at mærke kroppen. Gennem kropslig indlevelse, bliver de mere bevidste om egen og andres kropslighed. Den bevidsthed, som de udvikler gennem den kropslige indlevelse, får dem med det samme til at omsætte deres oplevelser til handling (for eksempel at stoppe en massage, der på modtageren føles ubehagelig) og omvendt farver handlingerne også deres oplevelser.

Afsluttende pædagogisk/didaktiske refleksioner

Musikpædagogen Deanne Bogdan (2003, p. 85) trækker paralleller mellem Csikszentmihalyis flow-begreb og æstetiske oplevelser. I begge slags oplevelser er det tydeligt, at der ikke findes grænser mellem selvet, kroppen og omgivelserne. Både flow-oplevelser og æstetiske oplevelser rummer sanselig involvering, og synes at være processer, hvor vi kan skabe mening i forhold til os selv, vores forhold til andre og den aktivitet, vi er involveret i. Men kan vi tale om læreprocesser, hvis der ikke gøres refleksioner over en oplevelse? Ved vi hvad vi har lært, hvis vi ikke kan udtrykke os om det? Og hvad er værdien af en læreproces, som vi ikke er bevidste om? I lyset af mine data bliver det tydeligt, at de studerende, fordi de får til opgave at beskrive deres oplevelser, udvikler en bevidsthed om oplevelsen/situationen, og hvad der er betydningsfuldt for dem, som de ikke ville have haft udviklet uden den opgave. I alle bevægelsesaktiviteter er den kropslige viden uundgåeligt tilstede hele tiden, og mange oplevelser kan være betydningsfulde for de studerende, selvom de ikke er blevet beskrevet i ord. Men op-

gaven at udvælge et betydningsfuldt øjeblik og reflektere over det gør, at den studerende skaber oplevelsen i sin bevidsthed. Før var oplevelsen kun tilstede på et kropsligt plan, måske som et øjeblik af velvære eller af at føle sig udfordret. Ved at forsøge at integrere de sanselige og kognitive processer virker det som om, de studerende udvikler en bevidsthed om, hvad de lærer og hvordan. Dermed udvikler de forståelse af oplevelsen på et dybere plan, som både udvikler deres viden om dem selv og om faget.

Metoden kan også medvirke til, at de bliver mere involverede i et fag (som nogle af de studerende nævner, er tilfældet for dem i forhold til "Kropsbasis") og til, at de bliver bedre til at fokusere på indlevelse i oplevelsen, som måske kan gøre flere oplevelser på studiet betydningsfulde. Derudover bidrager opgaven til, at jeg som underviser får en chance for at kigge ind ad et 'vindue', som ellers ikke er direkte synligt for mig. Jeg kan ofte fornemme deres respons på forskellige opgaver, men det meget rige oplevelsesunivers, der foregår i dem hver især i løbet af en undervisningsgang, er det meget spændende at få kendskab til. Det er jo ikke kun, når de bliver bedt om at skrive om deres oplevelser, at de har så forskellige og mangestrengede oplevelser – de er der jo hele tiden og i alle situationer. Oplevelsesbeskrivelserne hjælper mig med at huske det og med at være mere opmærksom på, hvad der mon foregår hos dem hver især. Når en pige f.eks. efter, at vi har arbejdet med 'kædekoreografi' (en metode hvor forskellige personers bevægelsesidéer bliver sat sammen til en kæde af bevægelser) og jeg siger, at nu tager vi helheden en sidste gang, spontant udbryder: "Nej, det er altså lidt kedeligt", tænker jeg: Ja, det synes hun, der er en erfaren gymnast måske, men jeg ved at der er mindst 20 på holdet, for hvem det er første gang i deres liv, at de har prøvet at kunne huske en bevægelsessekvens og danse den 3-4 minutter i træk. For nogle er det ikke kedeligt, men måske oven i købet en oplevelse, hvor de kommer tæt på en tilstand af flow. Det er – og bliver mere og mere – vigtigt for mig at huske spændvidden i de mange forskellige studerendes oplevelsesuniverser, og også at gøre dem opmærksomme på, at der er så store forskelle på, hvordan de forholder sig til forskellige opgaver og øvelser.

I et uddannelsessystem der tager kroppen alvorligt som en ressource for læring, udvikling og sundhed i bred forstand, vil det være betydningsfuldt, at både idrætslærere og deres elever lærer at være opmærksomme på egne og andres oplevelser og at kommunikere om det, de mærker, ser og føler i et kropsligt baseret sprog. I praksis er idrætsfagets muligheder for at anlægge et oplevelsesmæssigt perspektiv sjældent i fokus. Alle fagområder i idræt involverer kropslig aktivitet, men ofte er dans det eneste

område, hvor der arbejdes indenfor et æstetisk paradigme[3]. Som underviser kan man også i andre idrætslige fagområder arbejde med at facilitere studerendes æstetiske læreprocesser. Det kan man, som jeg har vist i projektet, gøre ved at hjælpe med at udvide studerendes bevidsthed om deres oplevelser og at blive gode til at udtrykke sig om dem. Konkret kunne undervisningsprocesser, hvor der fokuseres på legende og eksperimenterende gruppeopgaver, hjælpe med at udvide studerendes sensitivitet for bevægelse og opmærksomhed på forskelligheder i egne og andres kropslige oplevelser og løsningsmuligheder. En anden mulighed, som kunne bidrage til at fremhæve et kropsligt (embodied) perspektiv på læring i bevægelse, kunne være at arbejde med kropsopmærksomhedsøvelser i forhold til forskellige former for bevægelse og praksisfelter. Med mere fokus på sådanne tilgange kunne vi udvide de studerendes bevidsthed i og om bevægelse, understrege at kroppen ikke kun er en fysisk genstand, der kan trænes, men også en krop, der rummer følelser og erfaringer og i sine reaktioner er sanseligt forbundet med, hvad der sker i omgivelserne på forskellige planer.

Merleau-Ponty (1962,1968) understreger, at bevægelse er fundamentet for at kunne mærke sig selv og andre mennesker, og som mennesker påvirker og påvirkes vi altid af hinanden gennem vores kropsligheder. Det at tage den "levede krops" chiastiske og relationelle dynamik seriøst kunne bidrage til at udvikle vores bevidsthed om vores egen og andres måder at være kroppe på, at udvikle redskaber til at kunne mærke og arbejde med kroppen på mange forskellige måder og at forøge fokus på relationen mellem krop, bevægelse, omverden og sprog i uddannelsessystemet. En øget opmærksomhed, som er funderet i "den levede krop," kunne påvirke måder mennesker oplever sig selv og andre på. En sådan opmærksomhed kunne også få samfundsmæssig betydning, eftersom den kan påvirke menneskers velvære og indbyrdes relationer, som det fremhæves af de studerende i denne undersøgelse.

Alle navne er i opgaven ændret af hensyn til studerendes anonymitet.

[3] Professor i musikpædagogik Deanne Bogdan (Bogdan; 2003, p. 85) refererer til et æstetisk paradigme. Indenfor dette paradigme er fokus på "lived experiences."

A Kropsbasis

Indhold

Forskellige basale bevægelseserfaringer og tværfaglige kropsaktiviteter samt tematiseringer hentet fra f.eks. atletik, rytmisk bevægelse og redskabsgymnastik. I det tematiske forløb indgår: Samarbejde, kommunikation, kropskontakt, mental træning, rytme, tillid/tryghed, spænding/afspænding, kropsbevidsthed og kreativitet.

Målbeskrivelse

Den studerende skal gennem kropsbasis forløbet:

- Tilegne sig kropslige erfaringer og teoretisk indsigt samt demonstrere en grundlæggende kropsbevidsthed og gruppedynamisk bevidsthed på baggrund af det tematiske og praksisorienterede tværfaglige arbejde med f.eks. kropsoplevelse, grænser, kropskontakt, tillid/tryghed, rytme og samarbejde.
- Opnå en basal forståelse for det komplekse samspil mellem de kropslige, sociale, psykiske, følelsesmæssige og mentale processer i forbindelse med kropsbasis.
- Gennem læreprocessen udvikle en indsigt i de til mange målgrupper overførbare værdier og potentialer, der ligger i arbejdet med kropsbasis.
- Demonstrere evne til selvstændigt at integrere, udvikle, udtrykke, reflektere og vise såvel praktiske som teoretiske aspekter af den både kropslige, personlige og sociale læring. Også her skal den studerende demonstrere en grundlæggende kropsbevidsthed og bevægelsesfaglig kompetence.

15

Supervision of Students with Structured Student-centered Teaching

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Introduction

The quality and quantity of student supervision is often the key to successful graduate/postgraduate research. Typically supervision is viewed as merely a teaching relationship between the student and the supervisor during a given research project. The relationship, in most cases, does not follow a generic template but is formed on the teaching/learning activities carried out by the supervisor and the student. Students will usually be different and for a supervisor the relationship will therefore inevitably change on a student-to-student basis. These differences might be rooted in e.g. background knowledge, degree program, gender, age and nationality/cultural background which all, to some extent, affect the level of learning for individual students (Le & Tam (2007); (Calma; 2007)). Other differences in student learning, which should ultimately lead to different modes of supervision, come from student motivation and expectations. Student motivation ideally stem from curiosity about and general interest in the project. However, some students are only interested in getting their ECTS in the easiest possible way, and for them learning will be much harder and "shallower". The supervisor's job is therefore to induce enthusiasm for the project in the students, resulting in commitment from the students and ultimately a great project. As for student expectations, the student may expect the supervisor to help them every step of the way, or they may simply expect guidance at critical points in time during the project. Here, the supervisor needs to adjust the level of help to the individual student, so that every student will solve as many of his/her questions as he/she is capable of on his/her own.

In the department of Plant Biology and Biotechnology at Faculty of Life Sciences, University of Copenhagen, the supervision of students follows a contract which specifies project objectives, duration and location, frequency of supervision and covered subject areas. Such a contract not only adds a structured format to the research project but it also serves as an agreement on what to expect from the supervisor and the student during the project. In general, it might be naive to think that student supervision can be fully contained in a simple contract as the one used at LIFE. Particularly it might be questionable whether a contract-based supervision can be used for all students and supervisors with the same level of success especially considering the different backgrounds of students and supervisors. Also, this contract is not applied for international students where supervisors are not required to fill out anything accept the final examination form.

In this paper we examine how structured supervision helps and encourages students to learn in a research environment. The purpose was to assess how students view good supervision with respect to quantity and quality. In addition an investigation was made into whether a structured supervision format can be used successfully for students with different backgrounds. We focused on students that differ mainly by being national/international, inexperienced/experienced and doing projects that require little laboratory work/much laboratory work. The aim of the project was to create inspirational material for future student/supervisor relationships within Department of Plant Biology and Biotechnology at Faculty of Life Sciences, Copenhagen University.

Materials and Methods

Two Biotechnology students from LIFE, Copenhagen University, Andreas and Geziel, formed the basis of our study. They were supervised from the middle of April until the middle of June 2010 (around 8 weeks) in connection with a bachelor and an independent research project, respectively. The "size" of both projects was similar, amounting to 15 ECTS. Andreas was a Danish bachelor student aged 21, who started his studies in 2007 and was supervised by Rubini. Geziel was an international student aged 23 from Brazil, who started his studies in 2006 and was supervised by Mika. Both supervisors were superficially involved in the supervision of the other student, to avoid too much bias in the conclusions. The titles of the projects were: Effects of light and dark-treatment on cyanogenic glu-

coside metabolism in cassava (Andreas), and CYP405A2: Characterization of three novel non-coding regions in *Zygaena* burnet moths (Geziel). Although the project duration was similar in both cases, the structure was different. Andreas spent only three days on laboratory work and the remaining 7.5 weeks reading and writing his project. In contrast, Geziel spent 7 weeks on laboratory work and one week reading and writing his project.

The project outlines were defined in collaboration with the students and presented to them with Intended Learning Outcomes (ILOs) at the beginning of the project (Appendix A-B). The ILOs were designed using different levels of the SOLO (**S**tructure of the **O**bserved **L**earning **O**utcome) taxonomy (Biggs & Tang; 2007). We also presented the students with questionnaires before, during and after the project to asses how our supervision was evolving and if the students' view of our supervision changed during the project (Appendix C-E). The students were also asked to relate to the ILOs in the questionnaires (Appendix C-E). In the first questionnaire the students were to address factors they considered important to achieve their ILOs. In addition they had to state, in the beginning and midway through the project, if they felt the ILOs would be achieved upon completion of the project. After finishing the project the students were asked to reflect on whether they had obtained the ILOs. Midway through the project the students were formatively evaluated based on a project progress report which they submitted. This was used to assess the progress of the students toward the ILOs. If the students' progress was not satisfactory the teaching activities were adjusted accordingly to help the students attain the set outcomes by the end of the project. A summative evaluation was carried out at the end of the project where the students were given a grade in an oral examination on their project. After examination an informal interview was carried out to obtain the students' view on the whole project as well as the supervision process.

Both students received a "welcome package" on the first day of their project including the following:

1. Detailed project outline.
2. Small relevant paper collection.
3. Dates with structured supervision (approximately once a week).
4. ILOs.
5. First questionnaire.

Structured supervision was a meeting of 0.5-1 hour where the student and supervisor discussed issues/questions, which the supervisor would have

received in writing from the student no later than 2 hours prior to the meeting. During the weeks with laboratory work the student wrote up to half a page of progress report from the preceding week and this would also be discussed in the meetings. Day-to-day supervision were short informal meetings where students mainly asked specific questions about laboratory work and/or writing.

Results

Both students completed their projects on time, passed their oral exams, filled out all questionnaires, and participated in the final interview relating to this pedagogic project. In general, Geziel appeared to be very self sufficient and good at seeking information on his own during the laboratory work. In contrast Andreas, due to his inexperience, was less comfortable on his own and in the beginning relied more on help from his supervisor. After the initial guidance he became more confident and was capable of doing work independently in the laboratory.

During the writing phase there were also distinct differences between the two students. Andreas experienced several problems and found it difficult to adapt to writing on a scientific level that he was not previously used to. As a result he had underestimated the time needed for writing and ended up submitting an incomplete report. During the project he was asked to develop a plan so he could structure his writing, but this was not successful, since he was unable to do so. Geziel also had an issue with time during the writing phase, because the original two weeks set aside for writing were cut down to one week, as he decided to focus his attention on finishing the laboratory work. This turned out to be a bad decision, since the report was not as good as it could be, although it had all the necessary elements.

When defending the project work at the final examination, Andreas had some difficulties communicating his results at the proper scientific level, and this was received poorly by the examination committee. He had received guidance on how to prepare for his defense, but this may not have been clear. Geziel, on the other hand, presented his work at an appropriate scientific level, but he did not use his allocated time optimally, since he spent a lot of time on irrelevant details. Andreas acquired 7 and Geziel 10 as their final grade, which both students were very satisfied with. The supervisors also felt that the grades were justified, given the work produced during the project, and the students' presentations at the final examination.

Summary of the interviews after examination:

Andreas: The most fruitful experience Andreas had in his relationship with his supervisor was the practical training in the laboratory. He especially found the discussions concerning experimental procedures, instrument operation, and safety measures very useful before his laboratory work. This gave him the necessary security and confidence to work freely/independently in the laboratory. Andreas felt that he had received good constructive feedback on his writing, allowing him to learn and develop his scientific writing skills further. During the data interpretation he found it very useful that the supervisor guided him with questions so that he could analyze his data in a meaningful way. He was generally encouraged by his supervisor and found it inspiring to work in an environment where people were very knowledgeable about his topic and could help him when problems arose. He had underestimated the extent of the writing phase and would have liked more help, early in the project, in planning and structuring his writing. Generally he was very satisfied with the structured supervision and also surprised with the easy accessibility to his supervisor and the quick responses that he received on questions and feedback.

Geziel: Geziel was generally very pleased with the supervision of his project. He thought his supervisor had provided help whenever it was needed and/or directed him to where he could find answers to his questions. He had received good encouragement and perceived that communication had been easy between himself and his supervisor. He did not feel that anything was lacking in his supervision, but he would have liked a little more help with a certain aspect of his project (designing his primers) in the very beginning. He thought, that if he had been handed a paper on the subject and we had discussed the finished primers a little further, it would have been helpful. Geziel thought that the most fruitful experience he had with his supervisor was his observation of the excellent way she structured her work and her ability to multitask. He would try to adopt these strategies for his future studies and career. Generally Geziel gained a lot of experience from this project and he was very adept at pinpointing things that he wanted to improve in himself before doing another project.

Discussion

As observed from figure 1, Andreas and Geziel had some fundamental differences which have to be taken into account when evaluating the outcome

	Andreas			Geziel		
Answered questionnaire	**Beginning**	**Midway**	**After completion**	**Beginning**	**Midway**	**After completion**
1. Question about supervision						
A. I have as much supervision as I need	Agree	Fully agree	Agree	Fully agree	Fully agree	Fully agree
B. I have high quality supervision	Fully agree	Fully agree	Fully agree	Fully agree	Fully agree	Fully agree
C. I expect my supervisor to answer all my questions/did answer all questions	Fully agree	Agree	Fully agree	Disagree	Disagree	Fully agree
D. I expect my supervisor to help me find my own answers to my questions	Agree	Agree	Fully agree	Fully agree	Fully agree	Fully agree
F. *Your definition of good supervision*	A good supervisor gives "feedback" to questions in the form of counter questions and hints/tips about where the answers might be found	A good supervisor has a good talk/discussion with the student before the actual lab work. With emphasis on how to carry out the work and what safety measures to take	A good supervisor is a good listener who also puts a certain amount of pressure on the student in order to finish the project. Also warns about "time traps" like how much time different tasks (e.g data handling and writing) may take	I envision a supervisor as one who alights and propel a personal interest/ passion. I see him/her as a partner in the pursuit of knowledge	I would call it an "integrative" supervision where the interests of both student and supervisor are balanced towards the proper development of the project and the experience of the student	None
F. I expect to get most supervision during the following phases	Laboratory work, Writing phase, Data interpretation, Definition of project, Preparation for final examination	Laboratory work, Data interpretation, Preparation for final examination, Writing phase, Definition of project	Laboratory work, Writing phase, Data interpretation, Definition of project, Preparation for final examination,	Data interpretation, Writing phase, Laboratory work, Definition of project, Preparation for final examination	Data interpretation, Definition of project, Writing phase, Laboratory work, Preparation for final examination	Definition of project, Laboratory work, Data interpretation, Writing phase, Preparation for final examination
G. I think good supervision is essential for getting a good final grade	Agree	Neither agree nor disagree	Neither agree nor disagree	Neither	Disagree	Agree
H. I prefer my supervisor to be:	My friend, My boss	My friend, My boss	My friend, My boss	My friend, My boss	My colleague	My friend
I. I get most out of the following type of supervision	None	Day to day and structured weekly supervision. Does not matter when supervision is during the lab work or during the writing phase	Structured weekly supervision	None	Structured weekly supervision	Day to day supervision
J. Comments to day to day supervision and structured weekly supervision	None	The day-to-day supervision was especially useful during the laboratory work. Particularly for safety instructions and how to book and run various instruments. Weekly supervision was useful for writing phase. It allowed for small deadlines and help to avoid write blockade and waste time on wrong focus points	It is good to have the weekly supervisions, especially in terms of deadlines. In my case a demand for a draft version could be made prior to accepting me as BSc student	None	In a day-to-day supervision you get the chance to constantly obtain a follow-up and feedback from the supervision (good point), however you barely have time/space to experiment and try by yourself (bad point)	It is good to have a close participation. The supervisors supervision range could some problems
2. Question about your project/grade						
A. I like my project outline	Agree	Fully agree	Agree	Fully agree	Fully agree	Fully agree
B. I think I will have some problems with my project in the following areas:	None	Writing due to inexperience	N/A	None	Laboratory work (I wish I had ideal primers, I will have to work a lot on this later)	N/A
C. I think my grade was:	N/A	N/A	As I deserved	N/A	N/A	As I deserved
D. I had problems with my project in the following areas:	N/A	N/A	Writing. Takes time to adapt to a new way of writing projects where you focus on usable results and not on what was said by the supervisor. Also adjusting to citing scientific literature properly.	N/A	N/A	Writing (I did not plan and structure my schedule enough to have enough time for writing)
3. Question about your ILOs						
A. I have achieved many/some or all of my ILOs and will achieve the rest	N/A	Agree	Fully agree	N/A	Neither	Agree
B. Why I will or did fail some ILOs (if this is the case)	N/A	None	None	N/A	I am still in the primer improvement phase	Some of the primers did not work
C. What I need/needed from my supervisor to achieve the rest of my ILOs	N/A	None	None	N/A	Patience	None
4. General questions						
Obataining a "welcome package" has been helpful for my learning	N/A	N/A	Fully agree	N/A	N/A	Agree
Being part of a pedagogic project has resulted in the supervision being	N/A	N/A	Better than normal	N/A	N/A	Better than normal
I will recommend this type of supervision to others	N/A	N/A	Agree	N/A	N/A	Agree

Fig. 15.1. Overview of answers to questionnaires (Appendix C-E) by Geziel and Andreas. Note: In question 1F, elements are ordered from 1-5 where 1 is most/best and 5 is least/worst. N/A: not applied

of the supervision process. Firstly Geziel is a little older and slightly further along in his studies than Andreas. Secondly he is from Brazil, showing that he has courage and initiative to go study in a country where culture and language may be a challenge, and very different from what he is used to. Accordingly, we would expect Geziel to be more self-sufficient than Andreas, and this was also what we observed. Furthermore their personalities differed a lot, Geziel being very confident while Andreas was more insecure, this of course contributing to the differences in the outcomes of their projects.

From the first questionnaire it was evident that both Geziel and Andreas liked their project outlines and expected no problems with it. This was not surprising since they were involved in creating the outline together with the supervisor before starting the project. They both had high expectations for the supervision, which can also be expected at the start of a project. Andreas expected his supervisor to answer all of his questions while Geziel, more realistically, expected his supervisor to help him find the answers. Andreas also thought that good supervision was important for the final grade while Geziel did not think that this was such an important factor. Here we see, that Andreas seem to put more of the responsibility for his project on his supervisors shoulders, while Geziel does not. Andreas and Geziel both believed that they would achieve their ILOs in the beginning of their projects. The answers from the questionnaires generally show the students' high expectations and satisfaction with their project, although it already is evident that Andreas is not as independent as Geziel, since he expects his supervisor to answer all his questions.

Midway through their projects Geziel and Andreas still had high expectations for the supervision, and again Andreas expected all of his questions answered by his supervisor, while Geziel expected help to find the answers by himself. At this point they both considered that supervision is not the most important factor for getting a good grade. This shows that Andreas is starting to take more responsibility for his own project. Andreas and Geziel were still very satisfied with their project outlines, but now Andreas has some concerns about the writing phase and Geziel about the laboratory work. This was mainly due to problems they experienced in these areas at that time. As a result both students now thought that they would not achieve all of their ILOs.

After completing their projects Andreas and Geziel were both very positive about the structured supervision, even though Andreas expressed regrets about not optimally utilizing all the supervision he was offered. An-

dreas reckoned that good supervision had less to do with his final grade while Geziel was of a different opinion and thought that it definitely influenced his grade. This might be explained by the different grades that Andreas and Geziel were given. Andreas was given 7 for a good performance which displayed a good command of the relevant material with some weaknesses. Geziel obtained 10 for a very good performance that displayed high level of command of most aspects of the relevant material with only minor weaknesses. A good grade might be perceived from the student's viewpoint as a result of excellent supervision, while poor/mediocre grades might be viewed as bad supervision or the student's own fault. The good grade could also have resulted in Geziel wanting to credit his supervisor more, as a way of saying "thank you". Both students felt that they had received a grade they deserved, and both pinpointed that they had most difficulties in the writing phase of the project, although their problems differed. Andreas could not easily adapt to writing on a scientific level and had problems citing scientific literature accurately. Geziel had not planned enough time for writing, when structuring the project, and could therefore not hand in the high quality report he had hoped for. This is a common pitfall when doing projects with much laboratory work, where both student and supervisor are highly interested in the results of the work. Conversely, in projects that involve little lab work, like Andreas' project, where only 2 weeks out of the 8 weeks are allowed for completion of practical work, the students will require more close supervision to ensure they finish the laboratory work on time as well as meet departmental requirements. In Andreas case the laboratory work was not an issue as he completed it within 3 days, and was well within the time frame. Both supervisors tried to help the students with their problems in the writing phase, but obviously failed partially, and will take this into account when supervising other students in the future.

In his supervisor's opinion, Andreas nearly attained all of his ILOs. In his progress report, submitted midway through the project, he had managed to reach ILO1-ILO6. This was impressive since he was not that experienced with laboratory work to begin with. He had some difficulties with ILO7, however, when he had to summarize his laboratory work into a comprehensive report. A major obstacle he faced was learning how to write at an appropriate scientific level. He was not used to writing reports, where you emphasize your successful results and leave out or tone down things that went wrong. In addition finding and citing original literature was also problematic as he had learned to do this differently (and incorrectly) in previous projects that he had done. In this respect the supervisor perhaps should have

stepped in much earlier during the writing phase to make sure that Andreas had understood how to cite literature accurately. During the final examination he found it difficult to communicate his knowledge from the project to his peers (ILO9). Although he was guided on how to prepare for his examination and told what was expected of him, he did not manage to utilize it during his project defense. The supervisor also offered to go through his presentation and give feedback before the examination, but he decided not to use this opportunity, which he regretted afterwards. Upon completion of the project, we discussed how Andreas could further improve in writing and communicating at a scientific level and this was received positively. All in all we think Andreas developed a lot during the project and gained valuable knowledge.

In his supervisor's opinion, Geziel achieved all of his ILOs, although we could have wished for him to have obtained a little more experience on working with the obtained sequences (ILO 4) and in communicating his knowledge from the project to his peers (ILO 8). As for ILO 4, there simply was not time, since Geziel was stuck for a long time optimizing primers. Geziel also regretted not having enough time for this phase of his project. For ILO 8, we think Geziel was very good at communicating his results during the project, but at the exam, he had a hard time getting to the point, and needed to learn how to structure a talk better. Some of this was due to nervousness, and we simply could not have predicted that Geziel would have this problem. We discussed the problem after the exam, and Geziel agreed that he needed to improve this aspect of his communication. Geziel also had some thorough reflections on the whole project and pointed out things he wanted to improve in himself before the next time he did a project. This showed his independence and great interest in improving his own performances to be able to pursue a scientific career. All in all we think Geziels knowledge gain from this project was very worth-while.

After reflecting on the entire project, both students thought that they had achieved the ILOs specified for their project. Also, having specific ILOs to relate to throughout the project was a convenient way for the students to do self-monitoring on how far they were in the learning process. In addition, it also allowed the supervisors to fairly assess the students during the formative evaluation and change teaching activities, if progress towards the ILOs had not been successful. Both students found this type of structured supervision very useful and thought that having fixed meetings, where the supervisor had prepared issues that the students wanted discussed, were very rewarding for their learning. Both Andreas and Geziel agreed that this struc-

tured supervision was better than what they had received during previous projects, and would recommend it to fellow students. Day-to-day supervision and structured weekly supervision was well-received by the students, although the day-today supervision was considered better during the phase with laboratory work, and the weekly supervision better during the phase with interpretation of results and writing.

When analyzing the questionnaires in general, it was apparent that Andreas was very focused on the situation at hand, and did not think long term, while Geziel was better at seeing "the bigger" picture. This probably stems from the differences in their experience and Geziels greater independence. To Geziel, a good supervisor is more of a mentor alighting interest in the student, who can collaborate closely with the student allowing the student to benefit from the supervisors greater experience and knowledge. To Andreas, a good supervisor is more a person who answers all questions and perhaps has some responsibility for the project. Here we see that students with less experience take less responsibility for their own project and expect the supervisor to take care of everything. Naturally these students will need more guidance than more experienced students, but it is also the duty of the supervisor to induce more self-confidence and responsibility in this type of students so they take ownership of their project.

Generally both students developed a lot during their projects and were aware of their own weak spots and how they could improve themselves before doing another project. Accordingly, we believe that our supervision approach was successful and will recommend it to colleagues in the future.

Conclusion

The way we structured our supervision was well received by our students, even though they were two very different persons. Since older students with more experience often will be more self sufficient during the project, the supervision has to be adapted accordingly. Therefore it is crucial for a supervisor to quickly get to know a students strengths and weaknesses to be able to supervise them for optimal learning during the whole project. It is also very important for the supervisor to show enthusiasm about the project to motivate the student, and get them through the "rough" spots with good cheer. Applying well-defined ILOs as part of the student supervision not only helps the supervisor align teaching activities accordingly, but it also helps the student to get an overview of what he/she is lacking in order to

complete the project. We realize that it is difficult to extrapolate results from this small scale study to general guidelines for supervision, but we think that the overall importance of structured supervision with well defined ILOs as well as a quick assessment of each individual students needs are applicable in any supervision scenario.

A ILOs Geziel

At the end of the project the student should be able to:

1. Follow protocols for laboratory work successfully.
2. Write a thorough and comprehensive laboratory book
3. Sequence genes of interest:
   A. Extract genomic DNA from Zygaena insects.
   B. Design primers for genes of interest.
   C. Carry out and optimize PCR reactions. D. Clone correct PCR bands.
4. Work on obtained sequences
   A. Construct alignments and phylogenetic trees from genes of interest and other insect genes.
   B. Reflect on genes of interest compared to known insect genes.
5. Use knowledge obtained during education to solve problems arising in the project.
6. Summarize laboratory work into a comprehensive project report.
7. Search and find relevant literature for project report.
8. Communicate knowledge from project to peers as well as lay-men.
9. Reflect on the whole project during the project as well as after exam, to pinpoint problems and try to solve them.

B ILOs Andreas

At the end of the project the student should be able to:

1. Design and setup experiment.
2. Follow protocols for laboratory work successfully.
3. Perform metabolite profiling.
   A. Extract metabolites (cyanogenic glucosides).
   B. Analyze LC-MS chromatograms.
4. Perform gene expression analysis of cassava genes involved in cyanogenic glucoside synthesis/breakdown.
   A. Extract and isolate total RNA from cassava.

   B. Synthesize cDNA from cassava mRNA.
   C. Analyze and quantify gene expression by performing real-time reverse-transcription PCR.
5. Reflect on the relationship between cyanogenic glucoside amounts and gene expression levels of relevant genes in relation to experimental design.
6. Use knowledge obtained during education to solve problems arising in the project.
7. Summarize laboratory work into a comprehensive project report.
8. Search and find relevant literature for project report.
9. Communicate knowledge from project to peers.
10. Reflect on the whole project during and after exam, to pinpoint problems and try to solve them

C First, middle and last questionnaires

First questionnaire

General questions:

A. Age:_____
B. When did you start your studies (year):_____
C. Have you attended other further educations prior to the present one?
   Yes ☐
   No ☐
   If yes, which one? _____
   If yes, how long were you doing this other study?_____

1. Questions about your project:
   A. I like my project outline
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. I think I will have some problems with my project in the following areas:
      Lab work ☐
      Reading ☐
      Writing ☐
      Other:_____
      Specify problems:

2. Questions about your expectations of supervision:
   A. I will have as much supervision as I need
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. I will have high quality supervision
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   C. I expect my supervisor to be able to answer all my questions
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   D. I expect my supervisor to help me find my own answers to my questions instead of answering them all
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   E. Your definition of good supervision:
   F. I expect to get most supervision during the following phases (use numbers 1-5 where 1 is most supervision and 5 is least):
      Definition of project ☐
      Laboratory work ☐
      Data interpretation ☐
      Writing phase ☐
      Preparation for final examination ☐
      Other:_____
   G. I think good supervision is the most important factor for getting a good final grade on my project
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   H. I prefer my supervisor to be:

My friend ☐
My boss ☐
My college ☐

3. Questions about your ILOs:
   A. I will achieve all my ILOs
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐

4. Comments:

Middle questionnaire

1. Questions about your supervision:
   A. I have as much supervision as I need
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. I have high quality supervision
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   C. I expect my supervisor to be able to answer all my questions
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   D. I expect my supervisor to help me find my own answers to my questions instead of answering them all
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   E. Your definition of good supervision:
   F. I expect to get most supervision during the following phases (use numbers 1-5 where 1 is most supervision and 5 is least):
      Definition of project ☐
      Laboratory work ☐
      Data interpretation ☐
      Writing phase ☐
      Preparation for final examination ☐
      Other:_____
   G. I think good supervision is the most important factor for getting a good final grade on my project
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   H. I prefer my supervisor to be:
      My friend ☐
      My boss ☐
      My college ☐
   I. I get most out of the following type of supervision
      Day to day supervision ☐
      Structured weekly supervision ☐
      Other:_____
   J. Comments to day to day supervision and structured weekly supervision (good or bad things about both?)

2. Questions about your project:
   A. I like my project outline
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. I think I will have some problems with my project in the following areas:
      Lab work ☐
      Reading ☐
      Writing ☐
      Other:_____
      Specify problems:

3. Questions about your ILOs:
   A. I have achieved many/some of my ILOs and will achieve the rest
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. Why I will fail some ILOs (if this is the case):
   C. What I need from my supervisor to achieve the rest of my ILOs:

4. Comments:

Last questionnaire

1. Questions about your supervision:
   A. I had as much supervision as I need
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   B. I had high quality supervision
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   C. My supervisor was able to answer all my questions
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   D. My supervisor helped me find my own answers to my questions instead of answering them all
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   E. Your definition of good supervision:
   F. I got most supervision during the following phases (use numbers 1-5 where 1 is most supervision and 5 is least):
      Definition of project ☐
      Laboratory work ☐
      Data interpretation ☐
      Writing phase ☐
      Preparation for final examination ☐
      Other:_____
   G. I think good supervision was the most important factor for getting a good final grade on my project
      Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
   H. I prefer my supervisor to be:
      My friend ☐

My boss ☐
My college ☐

I. I got most out of the following type of supervision
Day to day supervision ☐
Structured weekly supervision ☐
Other:_____

J. Comments to day to day supervision and structured weekly supervision (good or bad things about both?)

2. Questions about your grade:
A. I think my grade was:
As I deserved ☐
Too high ☐
Too low ☐
Why was the grade not as you expected (If this was the case)?

3. Questions about your project:
A. I liked my project outline
Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
B. I had some problems with my project in the following areas:
Lab work ☐
Reading ☐
Writing ☐
Other:_____
Specify problems:

4. Questions about your ILOs:
A. I have achieved all of my ILOs
Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
B. Why did I fail some ILOs (if this is the case):
C. What could my supervisor have done to help me achieve all of my ILOs:

5. General questions:
A. Obtaining a "welcome package" which includes project outline, relevant papers, supervision schedule and ILOs has been helpful for my learning:
Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐
B. Being part of a pedagogic project has probably resulted in the supervision I have obtained being:
Better than normally ☐
The same as normally ☐
Poorer than normally ☐
C. I would recommend this type of supervision to a friend who was about to start on a project
Fully agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Fully disagree ☐

6. Comments:

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Undervisning af små hold

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Introduktion

Projektet her er bygget op omkring min undervisning i kurset 'Spektral Teori', som blev afholdt på overbygningen i matematik i blok 3. Som det ofte er tilfældet for sådanne kurser, lå antallet af tilmeldte studerende på omkring 5. Så både de studerende og jeg som underviser befandt os i en meget priviligeret situation med gode betingelser for læring.

Målet med projektet er på forskellig vis at undersøge hvordan man ved at ændre lidt på den klassiske undervisningsform bestående af forelæsninger og øvelser kan optimere læringsudbyttet for små hold. Mere specifikt: *Hvordan kan man bringe de studerende på banen, også til forelæsningerne?* Med få studerende på holdet skulle der være rig mulighed for tovejskommunikation.

Min planlægning gik dels på hvordan man som underviser kan stille spørgsmål eller opgaver undervejs i forelæsningerne og dels på hvordan man kan lade de studerende fremlægge dele af stoffet undervejs således at de i højere grad tager ansvar for kurset. Hvis de studerende er involveret og føler et medejerskab af kurset, så lærer de også mere – det er den bagvedliggende filosofi.

Der er en stor mængde litteratur om 'teaching small classes' til rådighed. Se f.eks. Teaching Small Classes i referencelisten for en oversigt over fordele, udfordringer og strategier i forbindelse med undervisning af små hold. Nærværende projekt beror i høj grad på egne erfaringer i kombination med diskussioner med kolleger og – i særdeleshed – samtaler med fag-

lig/pædagogisk vejleder. Desuden har Biggs & Tang (2007) gennemgående været inspirerende læsning.

Som guide til undervisningen på Swinburne University of Technology indeholder Devlin (2003) en 10-punkts plan over hvordan man kan forøge chancerne for at få aktive studerende. Jeg vil afslutningsvis kommentere hvordan indeværende kursus har forholdt sig til denne plan.

Kursets opbygning

Lad mig starte med kort at beskrive hvordan kurset var opbygget. Helt overordnet drejede det sig om at se på en klasse af 'objekter' med tilhørende sæt af 'data'. Målet var at finde frem til hvilke slags objekter der svarer til bestemte typer af data og vice versa; hvis data ser ud på den og den måde, hvilke objekter kommer de så fra? Tænk f.eks. på objektet som overfladen af en tromme og på data som de lyde trommen kan fremstille. Kan vi så høre hvilken form trommen har eller hvor stor den er? Og hvis der måtte være brug for en bestemt dyb eller høj tone, hvordan skal vi så designe vores tromme? Det giver et meget godt billede af hvad spektralteori er.

Allerede ved første forelæsning gjorde jeg det klart hvad kursets ILO'er (=intended learning outcomes) var. Jeg beskrev hvilke matematiske objekter vi skulle se nærmere på og hvilke typer af resultater vi ville være interesserede i – simpelthen for at give en ydre motivation og for at have en referenceramme hele vejen igennem kurset. Dernæst fortalte jeg at vi ville få brug for et større 'maskineri' for at kunne bevise resultaterne og håbede på at kunne pirre de studerendes nysgerrighed til hvordan dette maskineri mon virker. Kernen i kurset var nemlig at opstille et apparat som ville kunne hjælpe os med at svare på de spørgsmål vi ønsker at stille.

Samtidig gjorde jeg det klart hvordan vi ville gøre brug af undervisningstiden, med andre ord hvilke TLA'er (=teaching learning activities) der ville komme i spil. Til forelæsningerne ville vi se på teorien og jeg ville stille opgaver og spørgsmål undervejs. Til øvelserne ville vi samle op på baggrundsviden og fra tid til anden tage en afstikker fra hovedvejen, hvis det måtte se interessant ud. Øvelserne ville bestå af opgaver som skulle gennemgås i fællesskab. Endelig fortalte jeg at eksamen ville bestå af tre obligatoriske opgavesæt, som både ville samle op på det gennemgåede stof samt checke at man på egen hånd kunne bruge de nye redskaber.

Forelæsninger med spørgsmål og opgaver

Jeg så ingen grund til at slette forelæsningerne helt. For vi skulle have bragt en masse spillere på banen og specielt indledningsvis var der brug for deklarativ viden. I første del af kurset var målet nemlig at få et grundigt kendskab til vores 'objekter'. Dernæst skulle maskineriet opbygges, så vi kunne opnå resultater. Min egen erfaring som studerende er også at fremfor alene at læse på egen hånd er det fornuftigt at se og høre tingene blive forklaret. Desuden følte jeg at forelæsningerne ville være ideelle til at give de studerende et ekstra perspektiv med på vejen. Men det stod også klart for mig at jeg ikke skulle snakke med tavlen i to gange 45 minutter.

Ofte ville jeg starte timerne med spørgsmålet: "Hvor kom vi til sidst?" eller: "I dag skal vi snakke om sammenhængen mellem en række ting. Hvilke ting kender vi allerede til?" Den umiddelbare reaktion på sådanne spørgsmål ville måske være om han ikke engang kan huske det selv, ham forelæseren. Og første gang jeg stillede spørgsmålet var der også tavshed og undrende blikke. Men de studerende fandt hurtigt ind i rytmen og var klar til start fra førend forelæsningen startede. Vi kunne således starte med at minde hinanden om hvilke bolde vi havde i spil og hvor vi var på vej hen. Dels en måde at aktivere de studerende på men også en måde at give dem medansvar på.

Nuvel, det var ikke altid at der blev svaret lige med det samme. Det kunne kræve lidt tålmodighed og et par ledende spørgsmål førend de studerende kom på banen. Men egentlig virkede det bare som en nyttig feedback. Jeg fik allerede førend forelæsningen var i gang en idé om hvorvidt de studerende var med på vognen eller ej. Selv en ganske kort samtale kan give underviseren et godt billede af om forståelsen er der. Om nødvendigt kan man så samle op på nogle ting eller springe let hen over noget man egentlig troede havde voldt problemer.

Jeg har tidligere tit startet en forelæsning med at sige: "Sidste gang så vi nærmere på dette resultat. I dag skal vi så bruge det til at vise..." Simpelthen for at binde tingene sammen og gøre det klart, hvad vi bygger videre på. Når holdet er lille, kan man med fordel og meget direkte inddrage de studerende på dette punkt.

Hvad angik spørgsmål generelt under forelæsningerne havde jeg ikke noget fast mønster. De enkelte delemner i kurset var forskellige i natur og fremfor alt skulle spørgsmålene passe ind i sammenhængen. Både planlægning og øjenkontakt spillede en rolle for mine spørgsmål, som faldt i forskellige kategorier.

Hvis et resultat var nemt at indse, kunne jeg finde på at spørge hvordan vi let kunne nå frem til det. Når der så blev svaret og folk nikkede samtykkende, kunne vi gå hurtigt videre. Jeg tror også det gav de studerende en oplevelse af succes. Der var noget her de sagtens kunne finde ud af på egen hånd. Men mange ting i kurset var selvfølgelig mere kringlede og mindre åbenlyse. Her ville jeg prøve at stille spørgsmål som kunne få de studerende til at indse hvad problemets kerne var. De ville nok ikke kunne gætte løsningen, som senere ville blive formidlet. Men ved at have gjort sig problemstillingen klart, håbede jeg på en større interesse i at få fat på løsningen. Enkelte gange gennemgik vi tekniske beviser i fællesskab på den måde at jeg lod de studerende komme med indput i form af gæt eller kvalificerede bud undervejs. Men det kan hurtigt blive meget tidskrævende, så man skal træde varsomt.

Når en række nye begreber var bragt på banen, ville jeg ofte lade de studerende samle op på dem fremfor at repetere selv. Det vigtige er hvad de studerende tænker og at hjælpe dem med at få alle tingene på plads i deres læringsproces. De skal ikke bare lytte og tage noter. Mens det tit og ofte kan være nyttigt at 'tænke højt' under en forelæsning for at lokke de studerende til at tænke med, kan man når holdet er lille få mere direkte hjælp fra klassen.

Ved gennemgangen af de centrale resultater og altafgørende pointer ville jeg i endnu højere grad tvinge de studerende til gennem egen tankevirksomhed at opbygge deres viden, nemlig i form af små opgaver. Det spiller en stor rolle for succes at niveauet er passende, men alfa og omega er at afsætte tid nok. Det tager nemlig tid at regne opgaver, og man bør derfor ikke stille opgaver uden særlig relevans. Undervejs i opgaveløsningen kan man se de studerende lidt over skulderen – uden direkte at stirre, som kan virke skræmmende. På den måde virker man heller ikke så utålmodig som hvis man trasker frem og tilbage foran tavlen, og det giver en mulighed for at supplere med et par ekstra brikker til puslespillet om nødvendigt. Efterfølgende kan man samle op på opgaven i fællesskab og sørge for at alle bidrager til løsningen. Det giver en god stemning på holdet. Det er også fint at lade de studerende snakke sammen undervejs i løsningsprocessen, specielt hvis opgaven er af lidt sværere karakter.

Som afslutning på forelæsningerne brugte jeg undertiden spørgsmålet: "Hvad var det vigtigste du lærte i dag?" Det giver en god og hurtig indikation af hvor de studerende er og om de fik fat i hovedpointen eller ej.

Øvelsestimer med 'ping-pong'

Mens jeg som underviser var den primære kridtholder til forelæsningerne, ville jeg gerne have de studerende til at overtage denne rolle til øvelserne (som jeg deltes om med min instruktor). Et vigtigt element til øvelsestimerne er et behageligt klima. Hvis underviseren er venlig, imødekommende og åben for spørgsmål, så er de studerende heller ikke så bange for at give deres besyv med. Desuden er det praktisk at have rene linjer for hvad der skal ske og hvad der forventes af den studerende. Kommunikation er vigtig. Kaffepause og smalltalk kan også på forbilledlig vis medvirke til et godt klima.

Som nævnt tidligere var formålet med en del af opgaverne til øvelserne at skaffe brikker til det store billede, men på mere selvstændig vis. Andre af opgaverne ville sætte allerede etableret viden i perspektiv eller give en ny vinkel på tingene. Jeg kunne flere gange direkte mærke tilfredsstillelsen hos de studerende når postulater fra forelæsningerne nu faldt helt på plads.

Hvordan bærer man sig så ad som underviser til at få alle med, også dem som kun har set på eller regnet en lille del af opgaverne? Alt afhængig af opgaven kan man forsøge at starte en ping-pong samtale. F.eks. kan en studerende fortælle hvad den konkrete opgave går ud på, en anden give sit bud på hvordan den kan løses og en tredje validere om den påståede løsning er korrekt. Selv hvis løsningen er helt korrekt, er det godt at blive enige. Så tænker alle fremfor bare at nikke. Og hvis løsningen er forkert, må vi rette den eller prøve noget nyt. Det kræver overblik og hurtig tankevirksomhed at holde en ping-pong samtale kørende, men når det lykkes er resultatet der også. På små hold kan man med held få alle med og løfte både det samlede og den enkeltes niveau. Alle kan blive udfordret og alle kan få succes, da der næsten altid både er mulighed for lette og svære spørgsmål. En ping-pong samtale er en balancegang som alt andet lige er nemmere i et behageligt undervisningsklima.

Løbende evaluering af de studerende

Jeg vil ikke sige meget om kursets eksamensform. Valget faldt på løbende evaluering, som er standard. Så de studerende fik karakter på basis af 3 obligatoriske opgaver.

Første opgave handlede om en variant af kursets første hovedresultat, og anden opgave gik bag om en vigtig spiller i opbygningen af maskineriet

for at se tingene fra en lidt anden vinkel. Mens disse to opgaver var bundne og foregik skridt for skridt, var den tredje og sidste opgave mere fri. Vi havde i løbet af kurset brugt en stor mængde tid på at opstille et maskineri, og nu skulle de studerende på egen hånd bruge det til at vise et resultat som var nævnt i bogen men ikke bevist. Som hjælp på vejen fik de en artikel der skitserede brugbare metoder. Besvarelserne var blandede, fra meget overfladiske til gennemtænkte og detaljerede.

Sædvanligvis ville jeg tage en snak med hver af de studerende efter at have rettet opgaverne. Dels for at rose hvad der var godt i besvarelsen – og dermed skabe en følelse af succes – og dels for at snakke om de fejl, der måtte have været. Ved eventuelle fejl ville vi snakke om problemstillingen, finde frem til hvorfor den studerende var galt på den og i fællesskab finde frem til løsningen. Allerhelst ville jeg kunne give den studerende et par vink, således at han/hun selv kunne se hvordan man kommer frem til løsningen. Denne type feedback til de studerende er mulig for små hold men selv sagt ikke hvis der er flere hundrede studerende som følger kurset.

Afsluttende evaluering af kurset

Efter kursets afslutning holdt jeg en mundtlig evaluering med de studerende. De var godt tilfredse med bogen og det havde virket fint at stille spørgsmål og opgaver undervejs i forelæsningerne. Der havde været en god sammenhæng i kurset og niveauet havde også været passende. Dog kunne de godt have tænkt sig flere eksempler når nye begreber kom på banen. Og det havde jeg måske ikke tænkt nok over. For når man kender teorien ud og ind, er der ikke brug for så mange eksempler at hæfte sin viden på. Men kurset var overstået nu. Jeg ved det selvfølgelig til næste gang hvis kurset skal holdes pånyt. Men hvordan kunne jeg have sporet denne mangel tidligere i forløbet? Fra tid til anden sluttede jeg timerne af med at spørge: "Hvad er det vigtigste du har lært i dag?" Her kunne man til afveksling f.eks. spørge: "Hvad kunne du tænke dig at vide mere om på baggrund af i dag?" Med en lille klasse på hånden er der mulighed for at efterkomme relevante ønsker.

De mest interessante kommentarer fik jeg imidlertid til spørgsmålet: "Hvad er den eller de vigtigste ting du har lært i kurset?" Her nævnte en studerende at for ham havde det at udvikle det store maskineri været mere interessant end at bruge det til at vise resultaterne med – omend det også havde været spændende. En anden studerende påpegede at selv om kursets

egentlige mål var at relatere 'objekt' og 'data', så havde vi hele vejen igennem set på en tredje kategori af 'elementer' og bygget teorien op omkring disse. Naturligvis var elementerne her snævert forbundet med både objekt og data.

Så for den første studerendes vedkommende havde 'vejen' i sig selv været det bedste ved kurset, hvilket passede godt ind i mine læringsmål. Måske ville det være vel optimistisk at forvente at de studerende efter at have fulgt kurset øjeblikkeligt ville kunne sætte sig ind i f.eks. hvordan computertomografi virker. Men med interesse for de metoder der bruges i spektral teori er grunden lagt for at kunne gøre det på relativt kort tid. Når åbne problemer bliver løst indenfor matematikken, er det ofte ikke så meget selve løsningen som den teori der ligger bag som er interessant.

Den anden kommentar fortæller med al tydelighed at den studerende havde reflekteret over indholdet af kurset. Det sker tit i matematikkens verden at man med fordel kan se på nært beslægtede objekter, hvor teorien måske er mere glat eller bedre udviklet. Det gjorde vi i kurset og det havde han ganske rigtigt fanget, den studerende.

En 10-punkts plan

Som nævnt indledningsvis giver litteraturen mange input til undervisning af små hold. Den følgende 10-punkts plan er beskrevet og gennemgået i Devlin (2003):

A 10-point plan for facilitating participation

1. Create a conducive physical setting
2. Take introductions seriously
3. Use icebreakers carefully
4. Learn students' names
5. Set ground rules
6. Orient students to learning
7. Use even smaller groups
8. Avoid the traditional model
9. Ask good questions
10. Reflect, evaluate and renew

Nedenfor vil jeg kort diskutere disse 10 punkter (i passende rækkefølge) set i relation til det afholdte kursus.

Ad 2) Hvem er jeg og hvad skal vi? Hvilke forventninger har de studerende? Det er efter min mening utrolig vigtigt at præsentere kurset grundigt (jf. §2) og afstemme forventninger. Hvem gør hvad og hvornår? Undgå forvirring og nå frem til fælles regler (hvilket også er snævert forbundet med punkt 5) overfor). Deltagerne i mit kursus var modne og rutinerede studerende, så behovet for regler var minimalt.

Ad 4) Det er altid en god ide at lære de studerendes navne at kende, også på større hold. For det udviser interesse og på små hold er det en overkommelig opgave. Med under 5 studerende på holdet er det næsten svært at dele op i mindre grupper, som nævnt i 7). Men når det drejede sig om feedback på de obligatoriske opgaver, gav jeg den enkeltvis (jf. §5). Et bedre kendskab til den enkelte studerendes niveau kan også gøre det lettere at målrette spørgsmål til ham eller hende.

Ad 6) Hvis man beder de studerende om at samle op på det gennemgåede stof og på den måde orientere hinanden (f.eks. i starten af en forelæsning), så tvinges de til både at reflektere over stoffet og til at forklare det til andre. Disse to kompetencer fører til dyb læring. En vigtig forudsætning er naturligvis at de studerende har fulgt med i kurset og ikke er bange for at dele deres viden.

Ad 8) Som beskrevet i §3 besluttede jeg mig for ikke helt at forkaste den traditionelle undervisningsform, men snarere at give den et tvist i retning af mere diskussion og flere spørgsmål. Jeg anser det at kunne stille gode spørgsmål/opgaver som værende helt essentielt, se punkt 9). Gode spørgsmål får de studerende til at tænke og gode opgaver får de studerende til på mere selvstændig vis at indse centrale pointer. Jeg vil til stadighed reflektere over hvordan man stiller gode spørgsmål og opgaver. Hvad der virker eller ikke virker afhænger i høj grad af stoffet der gennemgås, men også af hvor godt man kender de studerende. Skal der skabes overblik, kan meget åbne spørgmål være gode. “Hvilke fordele og ulemper ser I ved brug af denne metode?” kunne være et eksempel på et åbent spørgsmål. Der er også brug for åbne spørgsmål, hvis en ping-pong samtale skal holdes kørende (jf. §4). Når alle detaljer skal forstås helt til bunds, kan mere lukkede opgaver derimod være gode. F.eks. kunne man bede de studerende om at regne modellen igennem fra A til Z i et helt konkret tilfælde.

Jeg har ingen væsentlige bemærkninger til 1) og 3). Der var fra dag et en god stemning på holdet og undervisningslokalet var fint nok.

17

Challenges to consider in the planning of cross-cultural and interdisciplinary courses integrated at Danish Universities: Diversity, Learning Style and Culture

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The *Erasmus Mundus Programme 2009-2013* is an incentive initiated by the European Commission to enhance and promote European higher education throughout the world (Executive Agency of Education, Audiovisual & Culture; 2010). This should be achieved by the establishment of joint programmes of "outstanding academic quality" which are designed and implemented by a consortium of European universities from at least three different countries. However, such consortia may also include universities from other parts of the world and the fellowships are open to higher education students and academics from all over the world. The programmes include study and research periods, in at least two universities and the students will be awarded their degrees by at least two universities in form of double, multiple or joint degrees. *Food of Life* is a new *Erasmus Mundus* course, which was recently established at the Faculty of Life Science in collaboration with the universities of Helsinki, Barcelona, and Uppsala. The admission criteria for the students include a good first university within one of the following disciplines: animal science, food science or technology or other biological sciences as well as a high proficiency in English (KU-LIFE; 2010).

From a teacher's perspective, it is already very challenging to run successfully an international course and/or interdisciplinary course. However, in this case, the situation is getting even more complicated as the students will be integrated in already existing course and be taught together with Danish students, which are neither participating in the *Erasmus Mundus* Programme nor being probably aware of the existing programme. Already

in the past, a number of Danish students have been complaining about their international fellow students based on the allegation that the international students would decrease the academic level of the courses. In the extreme, they refused to work in groups with international students, because the international students would decrease their chances to achieve high grades during the examination. It is well known, among students and teachers, that the high pass rate is lower for international students. Nevertheless, from former interviews with international students, we know that they enjoyed their stay in the Danish education system. Many of them did not consider their performance as lower or regarded the academic level as higher. Obviously, there are large differences in the learning styles culture, and these may not only exist between different nationalities but also between different study areas. In the past the foreign students had a status as guest students at the Faculty of Life Science and their experiences with a different learning culture was also an intended learning outcome of their stay (EU, 2010). In case of the *Erasmus Mundus* programme, the courses are by definition cross-cultural and inter disciplinary courses and are supposed to result in an outstanding academic quality. Though the *Erasmus Mundus* programme also allows for international staff exchange, currently the majority of the teachers involved are Danish and have neither had a former training in cross cultural communication and education nor have they been studying abroad.

Against this background, the project is aiming to explore the main cultural components in learning and/ or teaching style used in the Food Science education at the Faculty of Life Science, University of Copenhagen.

Methodology

In a first step, interviews with master and PhD students of different cultural backgrounds were performed about their points of view concerning differences in teaching and learning concepts between their home countries and Denmark. None of them has a former degree from the University of Copenhagen. A total of 7 students, of Chinese, Ethiopian, French, Belgium, Polish and German background, where interviewed in individual or group interviews. The interviews took place in block III and IV. The students have been chosen form different courses taught by the Department of Food Science. The form of the interviews was an open dialogue around the following central questions:

- "What characterises a *good* student?"

- "What is *good* teaching? What makes a teacher a *good* teacher?"
- "What types of examinations are used in your home countries?"
- "What are the major differences in teaching between your home country and Denmark?"
- "How do you get on the Danish system? How would you evaluate your own performance?"
- "How is the interaction with the other students?"

In addition to the students, three Danish teachers, one Swedish teacher and one German teacher were interviewed during block and III and IV about their experiences in teaching an international classroom. Also in this case the interviews were performed as an open dialogue around the following questions:

- "What characterises a good student"
- "What are the major differences between Danish students and international students?"
- "How is the expected performance of the international students?"
- "What is unique in Danish Way of teaching?"
- "What are the major challenges in a cross cultural classroom?"

After the examinations another enquiry about possible new insights gained by the teachers due to differences in the expected and real performance of Danish and international students did find place.

As each of the interviews lasted several hours, only a summary of the answers will be given.

The students' view

The evaluation of a student performance is strongly influenced by cultural differences. While in Western European countries the ability of critical thinking is very important, it was not mentioned by the Polish, Ethiopian or Chinese students. All students were in accord that a *good* student has profound knowledge of the subject matter. An interesting discussion arose during one interview around the attribute "hard-working". While the Chinese student considered the term as "a must" for a good students, it was strongly pointed out by the French and Belgium student that a "good student" is the one, who does not have to be "hard-working" as he or she is bright enough to filter the important information from the unimportant and

can consequently achieve a high pass examination with less effort. The European students point out that there might be a large difference between the recognition through the fellow students and the actually achieved grades during the examinations.

Good teaching was in general considered as well structured and prepared lecturing. Also the access to presentations and other teaching material is highly appreciated. In most countries, the teaching is solely build upon around available books or a compendium. All students want their teachers to listen more carefully and be more open to the student comments. The Chinese student pointed out that a *good* teacher should also be friendly. No student mentioned any deeper levels of learning as a requirement for *good* teaching, but the Chinese student points out that it is important that the teacher is scientifically up to date. The evaluation of the teacher by the students at the end of the course is not used in any other country and the Danish system is highly appreciated by all students.

In most countries written examination are used for student evaluations. This can be in form of an individual written project or a catalogue of different questions and calculations. The students prepare themselves by a list of problems mostly handed out by their teachers or older fellow students. No international student had any former experience with group work being included in an evaluation.

When the students were asked to compare the Danish education with the education in their respective home countries, almost all students find that at home

- more emphasis is placed on listening than speaking in learning
- less interaction occur between teachers and students
- while interacting, the communication from the student to the teacher is much more carefully due to the more hierarchically society
- repetition are used much stronger as means of learning
- but also more unity between knowing and doing
- the internet is rarely used in teaching
- less group work and never group work under evaluation

Large differences existed between the interviewed students with respect to their experience in group work, laboratory practise and report writing depending on their cultural or professional origin. For example students, which had a more technical oriented background, have more practise in laboratory work than students with a background in animal sciences. However, all students agreed that in their home countries only little emphasis is placed on the formal requirements in reporting: “Content is more important

than form". In general, the students felt that they had no problems to follow the Danish courses, though some thought that the Danish students had a better specific knowledge of the different food production systems.

The international students have very good contact between almost all cultural backgrounds - but miss contact to Danish students. They perceive the Danish students as not open and helpful. Cross cultural group work are normally formed only between international students. The teacher's initiative is required, if Danish and international students should work together. However, two students pointed out that in case of such group, the teacher should be aware of creating groups with more than one international student or more than one Danish student as they only work successfully, when no one is representing a minority.

The teachers view

The Danish teachers characterise a good student as a student who can think individually - while the German and Swedish teacher also request profound knowledge of the subject. "*Danish students are raised in thinking*" said one of the Danish teacher in the interview. The same skill is often missed in foreign students.

It can be summarized that teachers perceive Danish students in comparison to the majority of the foreign guest students as

- are more active in classes
- better in working in the laboratory
- better in thinking towards projects
- have less problems in "problem specification"
- write formally better reports
- are much more willing to discuss
- have less theoretical knowledge

The Danish Food Science education is unique in the strong use of group work and the strong training in thinking in forms of projects. Almost all courses include project work, which seems to play only a minor role in most foreign education. Also teacher agree, that the students experience in working in pilot plants and laboratories vary a lot, depending on their cultural and disciplinary background. A major problem is the disability to specify problems in project work. Regardless of the cultural origin, they expect that the teacher will define the problem for the project work.

With respect to the expected academic performance of the international students, the Danish teachers view is in accordance with the Danish students. Also they feel that the learning outcome in international courses is reduced compared to Danish courses. Almost the opposite view is taken by the international faculty members, which perceive the presence of the international students as a gain. Their argument is that international students are more open and more interested in learning compared to the Danish students. They also appreciated the background knowledge in basic sciences of the international students. All teachers agree that the students cannot be put in boxes according to their cultural background as in all cultures *good* individual students and *bad* students can be found. However, they also feel that Western European students from Nordic Countries, Germany, Holland and France easier adjust to the Danish teaching style than students from Eastern European countries, Africa or Asia.

Courses with international students are looked at as being much more demanding for the teachers as many more rules have to be explained. More effort has to be placed in making up for the differences in background knowledge and practical as well as theoretical skills of the different students.

All courses considered in this project were evaluated in form of a portfolio examination based on a project report and an oral examination related the project and general course content. The interview after the examination confirmed the expectation that in case of the Danish teachers the foreign students performed worse than the Danish students. Some of the foreign students protested against their assessments as they felt unfairly treated by the teachers. The opposite was the case in the course where the two international teachers were teaching and participating in the examination. Here, all students independently of the cultural background achieved the same level, however, based on different arguments. Interestingly, this result led to heavy protest from the Danish students who perceived their evaluation as to low when the foreign students could achieve the same results. However, in the following dialogues between the students and the teacher each student could agree to the grade given them, when their individual strength and weakness were discussed.

All teachers, independent of their cultural or disciplinary background, felt that the situation was very unsatisfactory and that the diversity in learning and teaching culture is creating much larger problems than anticipated. Despite of international students, which fail courses due to a lack of interest

in academic learning abroad, also *good* students, which are thought to be intelligent and knowledgeable, do not achieve the high grades.

Conclusions

In a time, where economic markets and political systems are increasingly affected by globalisation and internalisation, cross cultural and multidisciplinary education approaches become highly demanded by the authorities in order to ensure successful collaboration and communication between individuals and societies. This need is reflected in the *Erasmus Mundus* Programme 2009-2013. However, while the theoretical demand for a cross-cultural education can be easily seen, the practical implementation is rather challenging. Already the presence of international guest students is disturbing the routine in teaching and can create an environment, where students and teachers might not be satisfied with the learning outcomes. Those difficulties are manifested in the results of the student examinations. Running cross-cultural courses of an "outstanding academic quality" might require a very thorough preparation and in depth awareness of national peculiarities.

If a teacher is to facilitate successful learning opportunities for all students, he or she must know the students. This includes knowing about the innate personality and also learned cultural values that affect behavior. The learner is a product of "nature and nurture". The cultural background also affects the way individuals of different cultures interact. It became clear from the interviews that also the evaluation of the student performance is not free of cultural beliefs, attitudes and values. As it seems impossible to me to know all the cultural characteristics, I find it important that teacher of intercultural courses develop a critical awareness of themselves and their values, as well as those of other people in order to improve their teaching. This is necessary as the knowledge of the student's culture and learning style can help teachers to examine their own teaching practices and to become sensitive to providing diverse learning experiences. Intentional instructional diversity will be good for students from all backgrounds as all students at the end benefit from instructions given to certain students. With respect to the examinations of cross-cultural students, teachers need to be conscientiously of the fact that they tend to teach the way they way they were taught to learn. Considering that culture shapes learning style, there is a considerable risk that students who share a teacher's ethnic background will be favored.

Some practical suggestions for improvements

International students, which come from learning environments with very little emphasis on student activities and encouragement of critical thinking, will need some time to adjust to the Danish learning environment and to understand what is expected of them in Denmark. Especially, here group assignments with Danish students could theoretically be very helpful – if not the Danish students would be as unhappy about the collaboration with international students as they are. This might be explained by the fact that group work under those circumstances is challenging Danish students on many different levels as the majority of international students has had little experience with group work and do therefore not know how to work successfully in group assignments. This is where teachers really have to step in and to help the groups to recognize, develop, and apply critical teamwork skills.

In all newly formed groups with members which have no prior experience together, the largest problem is to begin to orchestrate work. This process may require considerably more structure and guidance about group processes than many teacher anticipate. By providing students with structure, teachers can help them to recognize, develop, and apply critical teamwork skills. This might include

- require students to submit a project proposal and timeline
- assign roles within groups or require students to
- set interim deadlines
- suggest ways for students to coordinate their schedules
- provide ways for group members to communicate with one another and the supervisor

Though assignments should always be clearly communicated, in a cross cultural context it becomes even more important that the objectives of the assignment are without a doubt communicated. The tasks have to be explicitly defined, the expectations have to be clarified, the performance criteria have to be communicated and even a model for high-quality work could be given. The same is true for the examination situation and might not only help the students to understand what is expected from them, but also remind the teacher what his/her own expectations of the students are. Therefore, I would suggest that examiners write down their evaluation criteria before the actual examinations. This might provide some protection for cultural bias.

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Investigating the role of analogies as tools for teaching topics in modern physics

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Metaphors and analogies play a very important role in human thinking and perception (Lakoff & Núñez; 2000) and we use them frequently when trying to understand or explain complex concepts (Bjerregaard et al.; 1995). Hence, analogies to classical physics are often the method of choice in didactic approaches to teach modern physics. However, many of these models describe certain aspects of a phenomenon very well, but do no longer apply when describing the more complicated contexts of the phenomenon. Inconveniently, these models or analogies are very difficult to erase or substitute because of their apparent inbuilt logic and simplicity. Here, the aim was to investigate the role of such models and analogies when studying the basics of NMR spectroscopy. Thereby, it was also explored whether alternative strategies to use models and analogies could be developed.

Introduction

Learning is a constant search for meaning. In the process of learning, learners often attempt to simplify new experiences and compare it to old concepts (de Haan; 2005). This new simplified concept of what has been learned will then be applied to future examples and the concept will be expanded. This process is generally described as conceptual learning (Wiig & Wiig; 1999). The study of sciences is usually considered as an ongoing progress where new information can be readily understood in the context of older concepts. However, it can be argued that scientific developments such as Quantum mechanics or Einstein's theory of Relativity clearly show

a discontinuity in the logic of sciences. In other words, for topics in modern physics, there exist certain epistemological breakpoints with classical physics and classical principles. Interestingly, the individual learner will overcome these breakpoints in a very individual manner due to their underlying personal psychological structure (Kuhn; 1969, p. 44). At such breakpoints, the use of institutionalised models or analogies that refer to concepts from classical physics can be a potential source of difficulties for students. First and foremost, instead of facilitating the epistemological break that is needed in order to be open for studying subjects in modern physics, often, these models do not impose the necessity of such breaks. Additionally, many of these models describe certain aspects of a phenomenon very well, but do not apply when describing more complicated contexts. Inconveniently however, these models and analogies are very difficult to erase or substitute because of their apparent logic and simplicity. Experiences with high school quantum physics teaching clearly show, how the overuse of such models based on analogies to classical physics hamper the students understanding of the subject at a higher level and as taught at universities (Euler et al.; 1999). Consistently, university teachers have to undo misconceptions and misinterpretations from previous teaching.

The course chosen to form the basis for the investigation is termed 'Protein Structure Determination'. In this course, master's degree students are amongst other methods introduced to NMR (nuclear magnetic resonance) spectroscopy and X-ray crystallography. The theory behind NMR spectroscopy is very challenging, and there exist various approaches and models to introduce NMR spectroscopy to the novice students. One of the favoured approaches is the so-called vector model, an model that uses arrows, representing the net magnetisation, being flipped around in a 3D coordinate system under the influence of external magnetic fields in order to explain certain pulse sequences. Another aspect of the vector model is that these "arrows", i.e. the net magnetisation, start "rotating" with individual frequencies within a rotating frame, which shall represent the radiation emitted from the various nuclei in a static magnetic field.

In this study, it was investigated whether it could be of help for the students' learning process if models for NMR spectroscopy using the traditional analogies to classical physics such as precession, torques and electromagnetic induction were omitted. Instead, the students were exclusively exposed to a qualitative view of NMR using approaches that try to visualise and apply the phenomenon (Rebello & Zollman; 1999). In detail, the focus of the teaching was set on practical exercises and real life-data. Further-

more, the course ILOs were designed to focus on how the phenomenon of NMR can be exploited to gain information about the properties of a protein on a molecular level instead of exposing the students to any detailed background theory. As part of the course structure, there is no final exam for this course. Instead, the final evaluation was entirely voluntary and based on various formats of open questions. Therefore, it was possible to design a non-performance based strategy for evaluation with a special focus on whether practical and/or qualitative foundations can form a better basis to promote the individual conceptual understanding.

Methods and Materials

In order to prepare a suitable teaching approach for the students, the guidelines according to "an instructional model aiming at a radical conceptual reconstruction" were followed (Kalkanis et al.; 2003). Formally, each course day consisted of a short introductory session to the day's subject (15-25 min), a 2h session of practical computer exercises with short breaks to summarise key points, and a 3h afternoon session with a journal club. For the journal club, students in groups of 2-3 were asked to present an article, which was then subject to group discussion. Articles were chosen so that they supported the day's message, but also contained an additional theoretical element, that could be discussed and explained in detail in cooperation with the presenting group. The presenting group was therefore given the opportunity to consult the supervisor prior to the presentation and informally discuss difficult issues they experienced when working with the articles.

Prior to the course, former colleagues were interviewed informally. A first questionnaire was given to the students during the first lecture, and a second one after the third lecture. Both questionnaires can be found in the Appendix (p.223). At the beginning of the third lecture, a mind map task was assigned (for the layout see Figure 18.1). After the course was finished, a focus group interview was conducted with 3 selected students according to their responses to the first questionnaire and the lack of response to the following two tasks.

Questions and assignments were given in open-ended formats. This resulted in a diverse response which did not allow statistical analysis and also might question the overall validity. However, this form of enquiry allowed that results were analysed phenomenographically (categorised in groups without referring to correctness) and contextually (responses were given

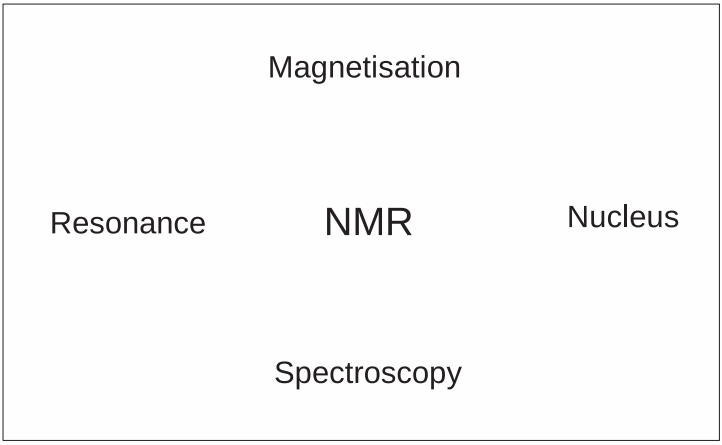

Fig. 18.1. Layout of the mind map task. Students were given these five words and the instruction to generate a spontaneous mind map with other individual expressions they were asked to set into relation to these five words.

in different concepts – what it has, what it does, what it is like – which provides information about the structure of mental models).

Results

A general feature of the course during the recent years has been the extremely mixed background knowledge. Before the first lecture, all 21 students were given a short questionnaire regarding their background knowledge and their motivation concerning the study of NMR spectroscopy. 17 students chose to answer this questionnaire. This served as a tool to gain insight into the composition of the course and highlighted the students' expectations. Roughly, students of the course PSD 2010 could be grouped into three groups: novices, intermediates and advanced. Novices stated that they had no experience with NMR spectroscopy, and had not taken the course 'Protein Science' in the third year of their bachelor program. The course 'Protein Science' covers certain aspects of NMR spectroscopy, but

leaves the theory widely untouched. This course had been taken by the intermediate group, and some of them also stated to remember some NMR theory from an earlier course in organic chemistry. Advanced students had taken both courses and had used/will use NMR spectroscopy in their master project. In addition, these students had already been exposed to conversations with supervisors or experienced fellow students, and hence have already begun to shape their views and theories on NMR spectroscopy. The exact composition of the 17 members of the course who chose to answer the questionnaire can be found in figure 18.2A.

In the following, the students were themselves asked to choose their favourite way to approach the study of NMR spectroscopy. In detail, they could state whether they preferred a theoretical and mathematical or a more practical approach or a combination thereof. Interestingly, with the increase of background knowledge there was a certain correlation between the wish to study theory and mathematics and the insight that the theory is too hard to study in such a short course. Despite the clear wish for getting the theory explained, students with increasing background knowledge would therefore prefer to study NMR theory in a rather bite-sized manner. The novices, in contrast, were polarised into a very motivated group ("novice c"), that considered an early exposure to the theory a prerequisite for an adequate understanding and a strictly opposed group ("novice a") hoping to for a more practical approach and the least possible theoretical way of studying NMR spectroscopy. For the exact distribution, see Figure 18.2B-D.

When asked for their usual sources to study NMR, novices mostly cling to the lecture notes and the recommended literature. Occasionally, they also quote Wikipedia as a good source for a general understanding. The confidence in standard textbooks vanishes quickly with the increase of experience, while the internet as a source wins drastically in importance. Students even seem to prefer much higher specialised articles over textbooks. The personal conversation with experienced students or supervisors also gains tremendously in importance. At the advanced level, the personal communication is clearly dominant when it comes to enquiring and understanding the theory behind NMR spectroscopy. This trend can be clearly seen from graphs E-G in Figure 18.2. This trend in combination with the lack of suggestions for a recommendable textbook, neither by students nor by experienced colleagues, clearly showed that the traditional ways for explaining NMR spectroscopy cause a lot of confusion among the students.

As an instrument to assess the progressive understanding of the students in the course PSD 2010, three methods were chosen. First, students were

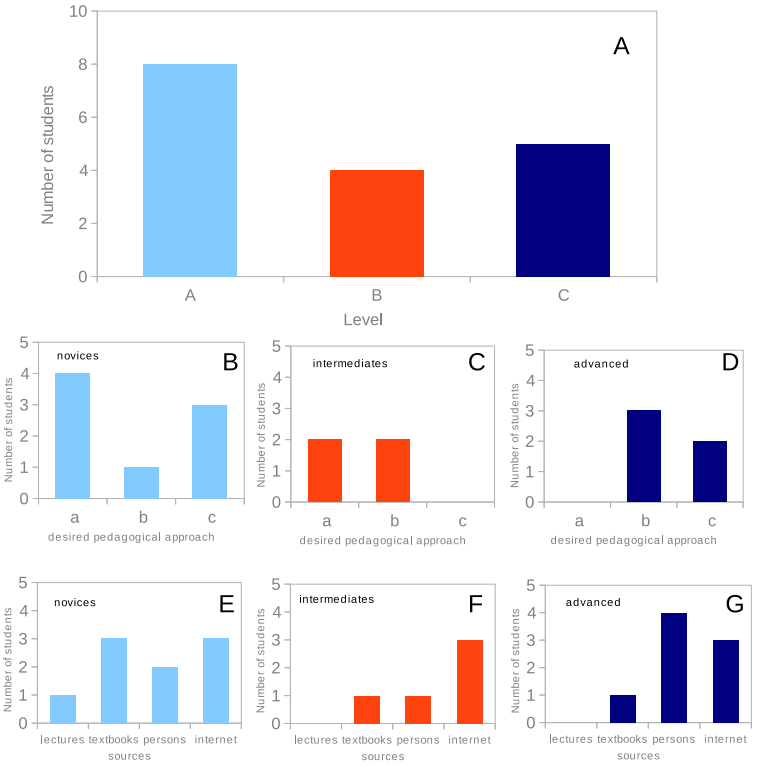

Fig. 18.2. Student background and expectations. 7 students were asked to provide information about other course attended that contained lectures on NMR spectroscopy. **A)** According to their responses, students were grouped into "novices" – no background, "intermediates" – have taken Protein Science A, B, or C, and remember NMR spectroscopy from organic chemistry lectures, and " advanced" – have taken both courses and use NMR spectroscopy in their bachelor and/or masters project. **B)** – **D)** Furthermore, students were asked about their wishes for a pedagogical approach to NMR spectroscopy: a) students that wished to study NMR spectroscopy by experiment, b) this group expressed a wish to hear about the theory, but were aware of, that it is difficult and hence wished for a slow and half-formal approach, and c) these students expressed a clear wish to study NMR theory on a theoretical and mathematical level. **E)** – **G)** Students were asked to list the usual sources they usually consult for self-studies. More than one answer was possible.

asked to create a mind map on NMR spectroscopy. Five students attempted to draw such mind maps, and despite several reminders, no students from the novice group were able to complete the task. Three mind maps were received from students from the group "intermediate" and two from the group "advanced". All five mind maps can be found in the appendix. In addition, two "expert" mind maps were collected from colleagues for the purpose of comparison. The mind maps have been summarised into three generalised mind maps which were grouped according to the individual levels in Figure 18.3.

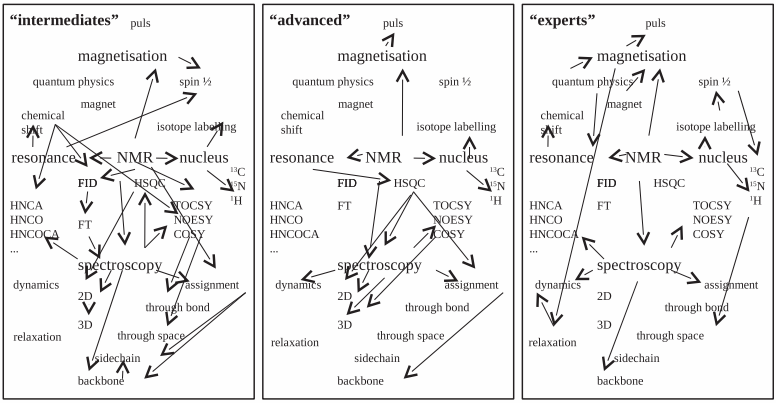

Fig. 18.3. Generalised mind maps from different levels of experience. "Intermediates" and "advanced": students grouped according to Figure 1**A**; "experts" refers to experienced people using NMR spectroscopy on a day-to-day basis for their research.

Common very interesting observations amongst the students are summarised first. Most interestingly, they all assigned high importance to the HSQC (heteronuclear single quantum coherence) experiment. In the mind maps, the term "HSQC" clearly stands separately and distant from other experiment types. This is also the experiment most relevant for protein biochemists and its use has been emphasised since the first day in the course. Another interesting observation was that all students managed to integrate "RESONANCE" into their mind maps. Interestingly, the teaching did not

focus much on explaining resonance and if so then in a very non-theoretical manner. This indicated a certain process in the generation of own theoretical considerations. As expected, there was a high connectivity concerning the expressions "SPECTROSCOPY" and "NUCLEUS" since the teaching sat a clear focus there. In contrast to the "expert" group, the field "MAGNETISATION" again was left relatively unconnected, maybe marginally more connected in the "advanced" group. This again was regarded as a clear sign for the lack of a detailed theoretical understanding.

Some clear differences between the two groups could also be noticed. The group "intermediate" could clearly incorporate the key elements of the teaching, such as the Fourier transform, the FID, 2D, 3D, HNCO, HNCOCA, HNCA, as well as the expression "chemical shifts". On the other hand, other expressions incorporated in the mind maps such as NOESY, COSY, were only introduced with minor emphasis towards the end of the lecture, mostly after the mind map task was handed out. Still, students also frequently tried to incorporate these expressions into their mind maps. This was seen as a clear sign for experiencing a more classical teaching approach prior to the course. Classical semi-theoretical approaches usually start to introduce multidimensional NMR via the NOESY and COSY experiments using the above described vector model. This historical way of teaching still persists even though the latter experiment rarely finds use in current practice. Finally, HNCA and HNCO, the multi-dimensional MNR spectra introduced in the second lecture of this course, were clearly assigned to the side of the word "RESONANCE" and were not connected to the word "NUCLEUS". This was seen as a clear indication that the obvious connection from the artificial labelling of the protein to the facilitation of the assignment could not be made by the students.

Generally, mind maps of "advanced" students contained fewer words. Considering NMR experiments, they only mention NOESY, COSY, TOCSY (not emphasised at this stage during the course) and not the experiments used in the practical part (i.e. these students are still stuck in "the classical way" of studying NMR spectroscopy). The course program put special emphasis on chemical shifts, and the lack of the term "chemical shifts" in the mind maps of advanced students was realised with great surprise. In addition, they did not include any of the key elements presented to the students during the course, e.g. FID, Fourier transform, chemical shifts, HNCO, HNCA etc., neither did they connect the different type of spectra they mention to the word "assignment" (the "assignment" task was the major emphasis of the practical part which encompassed 1/3 of the course

work). Instead, the students introduce a clear spatial separation between the two word groups considering various experimental procedures and various assignment strategies. This is surprising, as even the classical way of teaching NMR spectroscopy renders these two expressions the key elements when introducing the concept of multi-dimensional NMR and protein assignment. However, this separation can still be seen on expert level and might not be a lack of understanding but might also be seen as self-evident or likewise.

Interestingly, the students appear to have generated the mind maps in two groups of two students, as suggested by the remarkably similar layout of these pairs of maps. One of the pairs contained an "intermediate" and an "advanced" student. The most obvious difference between these two maps, despite a similar overall layout, is that the intermediate student has added the elements "chemical shift" and "Fourier transform" from the theoretical part of the teaching during the course. Another interesting observation from this pair, but also from the student pair "intermediate" student - "intermediate" student is, that certain words from the individual article presentations have found their way into the mind maps, such as "TROSY" or "natural abundance", subjects, which were both not emphasised in the actual lecture part.

Secondly, students were given questionnaires where they were asked to state their own opinion about certain aspects of, or requirements for, NMR spectroscopy in order to investigate their level of understanding. There was no response from the group "novices a" but three responses from the group "novices c", two responses from the group "intermediates", and again, two responses from the group "advanced". In general, answers looked very similar. This confirmed, that students from all levels were able to reach a similar level of fulfilling the course intended learning outcomes (ILOs). Students could reproduce the individual messages of the various theme days, and also to a certain degree formulate own opinions or argue about certain aspects of NMR spectroscopy. When asked about missing elements during the course, it was the "novices c" that claimed a general shortage of theoretical elements, while the advanced students considered the emphasis on article discussions when teaching the theory as "too repetitive". The intermediate group expressed great satisfaction with regards to the balance between the elements of the course. The confidence level in handling the literature and the general understanding of NMR spectroscopy had grown greatly in all three groups. While novice students were mostly expressing a better understanding of the general contents of articles, intermediate and advanced

students also state that they gained much more confidence in interpreting the data and in the quality evaluation of published articles as such.

Concerning the general understanding, "novice" and "intermediate" students seem to have a persistent misunderstanding of the word "isotope labelling". While most seem to be aware of, that "^{13}C- or ^{15}N-labelled" samples are used, they do not seem to make the connection to the ^{13}C or ^{15}N isotopes, but rather connect the word "isotope" with labelling methods that resembles radioactive labelling. This could also be seen from the lack of connection in the mind maps between the different nuclei types and the different experiments types. In general, both groups could explain how NMR spectroscopy can be used and what it can be used for, and could also list certain advantages and drawbacks of the method. The "intermediate" group had also developed a certain ability to self-evaluate the facts they have learned and stated, that "impurities as such are not a problem for the measurements directly due to the ratio between the compounds and the isotope labelling of the protein of interest, but the impurities can indeed indirectly interfere (e.g. through interaction with the protein of interest) with the quality of the spectra". From their answers, it can also be deduced that they must have started additional reading and have begun to shape their own ways of understanding the theory.

The group of "advanced" students clearly showed the ability to think autonomously and did incorporate additional thoughts and individual background knowledge into their answers. However, a very practical approach to the theory still persisted, which focused greatly on what the methods can be used for, not how the physical phenomena the different spectroscopic methods are based on resemble each other or can be distinguished. Due to their hands-on experience, they were able to answer the questions with much more practical insight.

Thirdly, the lack of a general theoretical introduction to NMR spectroscopy resulted in vivid discussions and explanations of theoretical elements of NMR spectroscopy on a direct level between the individual students and the teacher. Even though it was strictly avoided explaining NMR theory using the traditionally practised vector model, personalised explanations and analogies were continuously developed together with the students. As a result, many of the teacher's experiences throughout these discussions were also considered for the final analysis of this study. Such "personalised" models included e.g. very mathematical considerations of the influences of different shapes of the FID on the appearance of the spectra after the Fourier transform. The FID as a tool was therefore proven very

useful for a couple of students to describe certain aspects of relaxation. Another student showed a very good ability for abstract 3-dimensional visualisation and reasoning, and a mind model could be developed how chemical shifts and NOEs could be used indirectly to determine the structure of a protein. This lead to the student's insight, that we cannot visualise the 3D structure directly, as it is possible in methods such as microscopy, i.e. introducing the ability to break with a previous concept. A third group of students approached NMR data handling from a relatively abstract perspective that resembled data alignment methods. Interestingly, it has to be noted their journal club paper was also greatly covering protein sequence alignments prior to the NMR methods part. However, none of these individual approaches could be used to communicate the concept to the entire group of students, but mainly only showed fruitful results for the subset of students that initiated the respective conversation.

A final focus group interview focussed on a group of three students, that never expressed interest in studying the theory in order to see what kind of views these had formed on NMR spectroscopy ("novices a"). From the interview, it turned out that the students tried to study NMR spectroscopy before but failed to follow the old course right from the beginning. They confirmed that their theoretical understanding has not changed remarkably compared to prior to the course, but they could identify certain connections that they were not aware of before. They also stated that the NMR spectroscopic methods mainly used in organic chemistry differs greatly from the ones applied in protein sciences, and they expressed a great awareness that different teaching methods can help to make sense in the individual context.

The general impression was, that also in the group "novices a" the intended learning outcomes (ILO) have been met, and the three members of the group expressed a grown confidence in understanding and interpreting articles. They also stated that the combination of articles and computer exercises facilitated the understanding greatly. The students also discussed the possibility that difficulties in spatial thinking (Mitchelmore; 1980) especially by women, but also other student groups, could be a possible key issue for having problems with the classical models used in NMR teaching. They also stated that the possibility for them to create their own models and viewpoints, and the possibility for them to discuss these ideas on a very informal basis helped them best so far in the progress of understanding NMR theory.

Summary and Conclusions

When watching the students in the course and analysing the evaluation material, prior knowledge was identified to obstruct the incorporation of new knowledge at all levels and to overshadow the general perception of a subject. A good example here are problems with the term "isotope", but also the different approaches to "mind maps" with different levels of background knowledge. Interestingly, each student appeared to approach NMR theory from a very different and individual perspective. Here, it was observed during conversations with the students, that their "first close encounter" with NMR spectroscopy has evidently greatly shaped the students' view and approach towards the theory behind NMR spectroscopy. In the case of "novices" and "intermediates", this "first close encounter" was given by the individual article presentation. For the "advanced" group, experiences prior to the course were identified to form the key elements.

In general, from the observations and conversations throughout this project, it can be concluded that it indeed can be dangerous to impose analogies and models on the students and give them a certain degree of institutionalisation. Traditionally, models and analogies are considered a fundamental tool for explaining complex and difficult concepts. Here, it can be concluded that the danger lies within the attempt to understand and follow a concept using foreign (i.e. not-your-own) models and analogies. It must be kept in mind, that models and analogies might be a great tool for the teacher and scientist to express thoughts and ideas. However, it is not granted whether these models and analogies are understood in the same context on the student's side and do not lead to persisting misconceptions. As an example, one of the most remarking outcomes of the focus group interview was that a simple conflict such as male-female abilities of spatial visualisation might lead to a different perception of the standard models in use. Furthermore, it can be seen, that all students as individuals try to include their own personal encounters into their way of understanding institutionalised models and analogies. This is prone to create further confusion and diversion in discussions and conversations.

To summarise the outcome of the study, a practical and qualitative approach was very much welcomed by students with very varying background levels, and good learning progress was made through individual dialogues and hands-on experiences. The approaches to inquire problems in modern physics, in this case NMR spectroscopy, were found to differ in all individual cases. When omitting the more traditional models, it was noticed that

this created much more awareness for the students own approaches to develop theories about the nature of the phenomenon. Great successes were made during the individual conversation with the students, where models and theories were not taught as a fact but individually developed and discussed in a very phenomenological approach. These approaches were found to be very unique for the individual student but also only seem to work for only one or few students. When attempting to use models or analogies developed during personal communications in front of the entire group, this was again found to generate confusion amongst students.

From these most essential observations of this study, it is suggested, that a certain institutionalisation of analogies and models should be avoided. Instead, models and analogies should be individually developed together with the students. Thereby, students should be given the chance to develop their own approaches individually and "test" them together with the teacher in order to evaluate and develop their understanding. Following such an approach, the teacher becomes an interpreter of these models and analogies, but also as a moderator who encourages the break with classical or historical thinking. In the future, teaching strategies need to be explored that incorporate the newly-gained awareness of individual conceptual approaches better into the course planning.

A Questionnaires

Questionnaire 1:

What is your background knowledge on NMR spectroscopy: OC/spectroscopy courses, protein science courses etc., books, others and what are the most important things you remember from these courses?

What was useful in previous teaching, what was difficult to understand?

Do/Did you use NMR spectroscopy in your master project?

When did you get started being interested in NMR spectroscopy?

Why are you interested in NMR spectroscopy?

What is usually your main source of information about NMR spectroscopy (persons, books, internet)?

Can you recommend any textbooks/webpages that you think are good/bad. Why do you think they are good/bad?

Is a proper and detailed mathematical introduction frustrating or helping? Why? Would you be interested in learning this at a later stage or right in the beginning?

Do other spectroscopical phenomena help you to understand NMR? Can you give an example?

Can you think of possible applications to you own project? Why?

Questionnaire 2:

What is your scientific background (bachelor in Biochemistry, Nano, Bio, Chemistry, etc.?

What did you miss in the course?

What was overemphasized or could be cut down?

Would you like to learn more about the various spectroscopic methods? Which methods and what?

How confident do you feel in reading papers on protein structure determination after the course (also compared to before?

Can you name any fundamental similarities and differences between the spectroscopic methods like NMR, X-ray, but also Fluorescence or CD?

Where do the limits of the two methods NMR spectroscopy and Crystallography lie?

What do you think of recombinant proteins and isotope labelling? Why?

How important do you think is it to have clean samples for these various methods? And why do you think so?

There are always several ways to measure the same things. How do you think the choice of experiments can influence your results? Examples?

19

Curriculum Development, Alignment and Student Motivation in Molecular Systematics for students of Pharmaceutical Sciences

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Introduction

In the ideal world the student is motivated to learn by interest and the intellectual pleasure of learning associated with a high quality or deep learning approach. The responsibility for learning to happen can largely be handed over to the students and results are thereby improved. However, time pressure, the students preknowledge, interests, maturity, intellectual abilities, social background, self-efficacy etc. can lead to a learning approach characterized by external motivation. The student is then motivated to learn by the value of solving the problem, which is associated with a superficial or lower quality of learning.

Expectancy-value theory says that students are motivated to learn something if it is considered important to the student and the student also expects success when engaging in the learning activity. Effective teaching aims at helping the student to deep learning. Teaching theory and research has shown that deep learning largely depends on intended learning outcomes being clear and the student being motivated to reach them. Learning is also more efficient when students are activated by the learning activities. Other supporting conditions may be a trusting learning environment, using case based or problem based learning, and inspiration through the professional and encouraging engagement of the teacher (Biggs & Tang; 2007, ch.2–3, 7–8).

Aim and Objectives

The aim of the current project is to design curriculum for the subject Molecular Systematics as part of the BSc and MSc education in Pharmaceutical Sciences at the University of Copenhagen.

The project has three objectives:

1. To develop relevant curriculum and intended learning outcomes
2. To implement constructive alignment within and between BSc and MSc curriculum.
3. To implement student activation to improve learning efficiency and motivation

Curriculum and Intended Learning Outcomes

Teaching theory and research has shown that deep learning largely depends on intended learning outcomes being clear and the student being motivated to reach them. Intended Learning Outcomes (ILOs) can be defined as statements, written from the students perspective, indicating the level of understanding and performance the students are expected to achieve as a result of engaging in the teaching and learning experience (Biggs & Tang; 2007, ch.4). So we can ask, what are the students expected to learn, why and at what level of understanding?

Intended learning outcomes should ideally highlight qualitative understanding as for example defined by the SOLO taxonomy. The SOLO taxonomy (SOLO: structure of the observed learning outcome; Figure 19.1) provides a system for describing levels in approaches to learning from unistructural and multistructural to relational and extended abstract type knowledge or understanding (Biggs & Tang; 2007, ch.5). Furthermore, knowledge can be seen as declarative (academic) or functional (professional) depending on whether the theory component is a means in itself or a means to perform in a more informed or efficient way, which is often what professionals are expected to do after their education.

Intended Learning Outcomes for lecture in BSc course

From extracts of the course description of “Pharmacognosy and Natural Products Chemistry (M24-1)”, objectives related to the plant systematics

	Quantitative		Qualitative	
Prestructural	Unistructural	Multistructural	Relational	Extended abstract
Misses point	Identify, do simple procedure	Enumerate, describe, list, combine, do algorithms	Compare/contrast, explain causes, analyse, relate, apply	Theorize, generalize, hypothesize, reflect

Fig. 19.1. The SOLO Taxonomy, modified from Biggs and Tang, chapter 5, figure 5.2.

part can be drawn: "An introduction to botanical classification systems (particularly molecular systematics) and aspects of basic botanical terminology, constitutes the theoretical background for understanding connection between biodiversity and chemical diversity for relevant groups of plants and natural products. Emphasis is placed on pharmaceutically relevant compounds". However, for the students it may not be clear what the objective of each element of the course is and what level of understanding and performance they are expected to achieve. New intended learning outcomes were therefore developed. The intended learning outcomes for the BSc lecture is to work with a case to:

1. *explain* in a few sentences what a phylogeny is and how a phylogeny can be obtained from DNA-sequence data of plants. (declarational and relational understanding).
2. *apply* the principle of monophyly to identify monophyletic clades on a phylogeny. (functional and relational understanding).
3. *explain why* there is a connection between DNA-based phylogenetic classification of plants and the chemical diversity of groups of plants (declarational and relational understanding).

Intended Learning Outcomes for seminar in the advanced MSc. course

The MSc curriculum offers the course FFKKM9041, Advanced Pharmacognosy and for the first time in 2010 a four hour seminar on Phylogenetic Selection was included. Intended learning outcomes was developed that would build on the objectives of the BSc course focusing on introducing

the students to current research within the field. The intended learning outcomes for the MSc seminar is to work with a case and background theory in order to learn to:

1. *identify* the major critical tasks needed to carry out a phylogenetic analysis and *reflect* on the scientific quality of an actual phylogenetic analysis (declarative-functional and unistructural-relational knowledge)
2. *design* a basic phylogenetic study of DNA-sequences (functional, relational knowledge)
3. *reflect* on the potential of using phylogenies as selection tool in natural products drug discovery (declarative, extended abstract)

Constructive alignment

Based on constructivist theory learners construct their knowledge through their own activities. Intended outcomes should therefore *specify the activities* the students should engage in to achieve the intended outcome and the activities should be *aligned* to the intended outcomes. Likewise, intended learning outcomes, teaching and learning activities (TLAs) and assessment tasks should be aligned (Biggs & Tang; 2007, ch.4).

For example, one of the intended learning outcomes for the BSc lecture is to: "*apply* the principle of of monophyly to identify monophyletic clades on a phylogeny".

To engage the students in relevant learning activities, the students are presented with a phylogenetic tree of the angiosperms and asked to discuss if monocotyledons and dicotyledons are monophyletic on the displayed tree. The students thereby actively do what the intended learning outcome says. Likewise exam questions are designed to test if the student has achieved the intended learning outcomes. As part of a multiple choice exam, the students are for example presented with a cladogram of the Eudicots and must answer yes or no the question: "Rosidae (Rosids) are a monophyletic group".

Likewise, one of the intended learning outcomes for the MSc seminar is to: "*reflect* on the potential of using phylogenies as selection tool in natural products drug discovery"

In the beginning of the seminar, before the intended learning outcomes are presented, the students are asked: "Why do you think we have included a seminar on phylogenetics in this course?". During the seminar the students are presented with an example from the teacher's own research, which

uses phylogenies as a selection tool as well as with a list of potential advantages of phylogenetic selection.

In the multiple choice exam, the students are then asked to answer yes or no to the statement: "Phylogenetic selection aims to identify the most interesting plants for further study."

Student Activating Teaching and Learning Activities

Students learn better when they are activated and actively work with the subject. Lectures are often structured with a very low or no degree of student activation, partly due to traditions, and partly due to the belief that it is close to impossible to activate students in a large-classroom or lecture situation. However, there is a range of activities that can be used even in a lecture situation to activate students such as asking questions and allowing time for individual reflection or discussion with the neighbor. Problem or case based learning ideally is well aligned to intended learning outcomes, has the potential to improve student motivation, to make connections to pre-knowledge, activate students and construct functioning knowledge (Biggs & Tang; 2007, ch.8–9).

To make connection to previous knowledge, the MSc seminar was opened with the question: "Do you have any previous knowledge of phylogeny?". Suggestions are written down on the board. The next questions are designed to motivate the students by reflecting on the relevance of the subject and by letting them take ownership of the intended learning outcome: "Why do you think we have included a seminar on phylogenetics in this course? What would you like to get out of today?". In the BSc course the relevance of the subject is instead listed upfront on the very first slide.

In both the BSc lecture and the MSc seminar, a case is introduced which forms the basis and provides a framework for the teaching and learning activities. In the BSc lecture, students are introduced to a news report from the Independent, which is handed out as reading preparation for the lecture. Together with the teacher, part of the lecture then focus on exploring the background for this news article as well as introduce the theory and methods of molecular systematics. In the MSc course, an article from the teachers own research is used to go through the intended learning outcomes. The article has been given to the students as preparation reading for the seminar.

In the end of both teaching sessions, students are asked to review what they have learned to improve lasting retention. An example of activities for

review and self-evaluation is: “Make a few sentences, a list or a mind-map of the most important points in todays seminar. Then discuss with your mate and update your own points as relevant”.

The MSc seminar is a teaching session of four hours. Effective learning is therefore supported by changing activities and activate through questions and interaction. The first part of the seminar is used for introduction to the subject and the case, then one hour is used to do a computer exercise in the databar. The students are given a protocol to follow which allows them to use the internet to find sequences related to the case in Genbank, do alignment and simple phylogenetic analysis and reflect on the results. The last part of the seminar is then used to explain how the phylogeny was used in the chosen case to identify promising candidates for traditional medicine and lead discovery.

Evaluation of MSc seminar

The seminar on the MSc. course was evaluated by the students at the end of the seminar using a questionnaire with three open questions evenly spaced on a single page handout.

1. Which parts of todays seminar did you like most and why?
2. Which parts were not so good and why?
3. Do you have any suggestions for improvement of the seminar in the future?

In summary, the majority of the students liked very much to work in the databar, but some felt there was too little time and a few felt they spent the time following the manual rather than reflect. They felt the practical exercise both helped them to understand the theory and get an idea about how much work is needed to produce a phylogeny. It was clear during the computerlab that some students found it very easy and others very difficult. One student pointed out that it is exiting that the teacher uses her own research as example. The concluding part helped everything fall into place. The specific part on the statistics and variety of methods for phylogenetic analysis was very hard to follow and most of the students felt it should be simpler rather than more detailed. In the future, the introduction to methods should be shortened and simplified, there should be more time in the databar, the manual should be uploaded to the course website before the seminar and perhaps there could be more time for the concluding part. It

was also planned to give the students a case to reflect on towards the end, but it had to be skipped due to time pressure and it may be difficult to find time for this.

Examples of student comments:

"It gave a good introduction to the phylogenetic selection and what it could be used for."

"Statistic methods. Not enough time to tell the whole story or learn it, but too detailed to be easy to understand. The computer part had a lot of learning to deal with the problem and less time to understand it."

"Less about the statistics and more about the consequences of the statistics."

"The practical part could be longer, but the practical guide for the computer was really clear."

"I liked the practical part on the computer because it gave me a real view about phylogenetic work and I understand better the theoretical part."

"Good to try and use the programs, gave a little feeling of how difficult it is, and gave a good felling when we got something out of it."

"I discovered an interest in the subject today so it is good for me."

"The most interesting: you´re speaking about your own work."

"The conclusion (last part) was the most important. It was then everything fell into place."

Discussion

Many new concepts on using preknowledge, student activation, interaction between student and teacher, case or problem based learning, self evaluation, explicit intended learning outcomes and constructive alignment was used. The students were generally happy with the structure and activities, but on the BSc lecture, all the great ideas, preplanning and structure impacted on the freedom to and expression of enthusiasm. A little less structure in the future will allow for more time to reflect, and more emphasis on

what is the important take home messages. The MSc seminar was aligned to build on top of the intended learning outcomes of the BSc lecture, but the students preknowledge turned out to be less than expected and varied drastically between students. Half of the students on the MSc course were from abroad and had not followed the BSc course offered at FARMA. The theoretical introduction to phylogenetic analysis and the various methods was considered long and difficult by the students.

In conclusion, a major point to be learned is that it is difficult but important to make *realistic* intended learning objectives that are relevant to the students preknowledge and timeframe for the subject. Another important lesson learned is that less is better. It is very easy to overload the students with information, which they then have difficulties retaining. Based on the number of blanks in the multiple choice exam, the MSc students actually found phylogenetic selection the most difficult subject in the course.

However, all in all it was very exiting and inspiring for the teacher to experiment with a range of new concepts and teaching and learning activities and with more practice it is very likely that the use of relevant teaching and learning theories and practice can greatly improve the experience and the outcome of the teaching and learning activity. If the intended outcome is to make more efficient teaching and learning, the teacher needs to engage in relevant activities such as designing and practising efficient teaching.

Conclusions

New curriculum for the subject Molecular Systematics as part of the BSc and MSc education in the Pharmaceutical Sciences at the University of Copenhagen was designed and introduced. A range of theoretical and practical considerations for improving efficient teaching and learning were explored focusing on motivation and activation of the students. The new curriculum and activities are considered a great improvement on previous curriculum design, but the teaching and learning sessions can be further improved by reducing and simplifying the number of activities allowing for more flexibility and even more student activation, especially in the advanced MSC seminar. Just as students can, teachers can improve by practice.

A Example of slides used in the BSc lecture (1-3) and the MSc seminar (4-6).

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Scientists reclassify all plants

Michael McCarthy, Environment Correspondent, The Independent
Monday, 23 November 1998

THE SCIENCE of botany has been turned upside down by a new classification of the world's flowering plants and trees based on their DNA rather than their appearance.

Worked out by a team led by scientists from the Royal Botanic Gardens at Kew, south-west London, it has caused a complete rethink of the relationships between many plant families. It shows, for example, that the closest relative of the lotus, the sacred flower of Buddhism, is not the water lily it so much resembles but the the smog-resistant plane tree of London's squares.

When it is published next month in the Annals of the Missouri Botanical Garden, the classification, which for the first time establishes the relationships of all plant families through their genetic material, will do away with 200 years of previous plant taxonomy dating back to Linnaeus. This has hitherto been based on flowers' and trees' morphology - their appearance and visual characteristics, such as how many leaves or petals they have.

But the ability to examine plants at the molecular level, which has become available on a large scale only in the 1990s, makes clear that many of the relationships botanists previously assumed from morphology are wrong.

There are many surprises in the new classification. The papaya is not related to the passion flower, as was previously thought - its closest relative is the cabbage family; roses are closely related to blackthorns, nettles and figs; and peonies are not related to buttercups but to the saxifrage family.

The classification is the work of nearly 100 scientists led by Mark Chase, head of the molecular systematic section of Kew's Jodrell laboratory, and two colleagues, Kare Bremer of the University of Uppsala in Sweden and Peter Stevens of Harvard. It has taken more than seven years and involved the detailed comparison of three genes for each of 565 representatives of all the families of flowering plants. Most of the work has been done at Kew.

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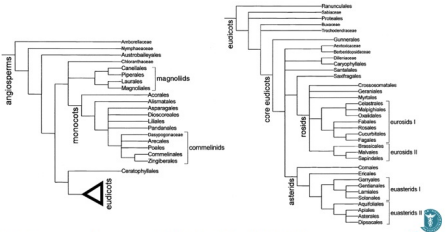
The first Angiosperm Phylogeny Group classification, APG I (1998)



Link from course homepage, Judd et al. 2002, APG II 2003.

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Questions to 'Scientists reclassify all plants'

1. Why can DNA-sequences say something about the relationship of the plants ?
2. How have the researchers produced the new classification ?

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Todays agenda (8-12 am)

1. Discussion on what and why phylogeny ?
2. Introduction to Phylodrugs and Amaryllidaceae tribe Haemantheae
3. Major tasks in a phylogenetic study
4. Computerlab (databar)
5. Tribe Haemantheae part 2
6. A case/exercise on phylogenetic selection
7. Take home messages – self evaluation

Slides will be in Absalon soon

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Taxon sampling – what material should we include ?

Haemanthus 22 spp.
South Africa, winter rainfall region, bulb

Clivia 4 spp.
South Africa, coastal forests, rhizome

Gethyllis 32 spp.
South Africa, Namibia, semiarid areas, 1 flower, bulb

Apodolirion, 6 spp.
Southern Africa

Scadoxus 9 spp.
Sub-Saharan Africa, rhizome

Cryptostephanus 3 spp.
Tropical Africa, rhizome

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Taxon sampling – what material should we include ?

- Percentage coverage
- Represent known "diversity"
- Key taxa (e.g. medicinal plants)
- Outgroup (root tree/establish monophyly)
- Availability (ID, age/quality)
- Genbank/EMBL or sequence from scratch
- DNA banks…

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